VOL. XXIII MARCH, 1925 No. 3

JOURNAL of FORESTRY

Published by the

Society of American Foresters

Single Copies 65c **Yearly $4.00**

Entered as second-class matter at the post-office at St. Paul, Minn., under the Act of March 3, 1879. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized November 20, 1918

JOURNAL OF FORESTRY

A professional journal devoted to all branches of forestry

EDITED BY THE EDITORIAL BOARD OF
THE SOCIETY OF AMERICAN FORESTERS

Officers and Members of Executive Council of the Society of American Foresters for 1925

President, S. T. Dana, Amherst Agricultural College, Amherst, Mass.
Vice-President, R. T. Fisher, Athol Road, Petersham, Mass.
Secretary, C. G. Smith, Forest Service, Washington, D. C.
Treasurer, C. R. Tillotson, Forest Service, Washington, D. C.

Executive Council

The Executive Council consists of the above officers and the following members:

	Term expires		Term expires
J. G. Peters	Dec. 31, 1929	R. C. Bryant	Dec. 31, 1926
E. H. Frothingham	Dec. 31, 1928	Raphael Zon	Dec. 31, 1925
R. Y. Stuart	Dec. 31, 1927		

Editorial Board

Raphael Zon, F. E., *Editor-in-Chief*

Emanuel Fritz, M. F.,
Forest Utilization and Technology,
University of California

A. B. Recknagel, M. F.,
Forest Mensuration and Organization,
Cornell University

B. P. Kirkland, M. F.,
Forest Finance,
University of Washington

G. B. MacDonald, M. F.,
Forest Education and Farm Forestry,
Iowa State College

Barrington Moore, M. F.,
Forest Ecology,
New York, N. Y.

J. W. Toumey, M. S., M. A.,
Silviculture,
Yale University

T. S. Woolsey, Jr., M. F., *Policy and Administration*
New Haven, Connecticut

The Journal appears monthly.

The pages of the Journal are open to members and non-members of the Society.

Manuscripts intended for publication should be sent to Raphael Zon, Lake States Forest Experiment Station, University Farm, St. Paul, Minn., or to any member of the Editorial Board.

Missing numbers will be replaced without charge, provided claim is made within thirty days after date of the following issue.

Subscriptions, advertising and other business matters may be addressed either to the Journal of Forestry, University Farm, Saint Paul, Minnesota, or to Atlantic Building, 930 F Street N. W., Washington, D. C.

JOURNAL OF FORESTRY

VOL. XXIII MARCH, 1925 No. 3

FOREST MANAGEMENT ON FEDERAL LANDS

BY W. B. GREELEY

Chief, U. S. Forest Service

The law of June 4, 1897, set up the basic administrative policy for National Forests. It names three purposes for their creation, namely:

1. To improve and protect the forest.
2. To secure favorable conditions of water flow, and
3. To furnish a continuous supply of timber for the use and necessities of citizens of the United States.

The last language was not included in the statute by accident. It was a mandate for a system of administration that would provide a sustained yield of timber. Improvement and protection of the National Forests is only the starting point. Prevention of losses by fire and insects, while indispensable, is simply the foundation of forest management. The planting of denuded areas and the development of silvicultural practice, while equally indispensable, are not ends in themselves. They are rather means of attaining the more fundamental object of providing a continuous supply of timber.

In a number of western states, the area of the National Forests is sufficient to make them an important factor in the future regional production of timber and the stability of forest industries. Under such conditions the management of National Forests for a sustained yield has industrial and social bearings of real importance to their regions. With an estimated stand of around 590 billion feet of stumpage, and a possible yield of 6 or 7 billion feet annually, the National Forests in the regions where they are largely concentrated can contribute materially to the permanent cut of timber products, the stability of industrial operations and investments, and the maintenance of a desirable type of permanent logging and manufacturing communities.

In the states east of the Mississippi River, where only three per cent of the wood-producing land is in National Forests, a sustained yield scheme of management will have more largely an educational and demonstration value. The actual contribution from the National Forests in this part of the country to the production of timber and the stability of forest industries and communities will necessarily be small. But for its educational value in forest management, I regard the sustained yield principle fully as important in the administration of the eastern National Forests as in those of the west.

Any permanent system of forest management requires a sufficient consolidation of land ownership within the natural operating units. In this respect the development of the National Forests is still handicapped at many points. The net area of government owned land within their boundaries is now about 157,505,000 acres. Intermingled with these federal holdings there are over 25,300,000 acres of privately owned land. One of the important steps which must precede the full development of management plans is the consolidation of federal holdings with a view to bringing under public ownership as much as practicable of the land comprising natural working circles. In the western states, we must look for the accomplishment of this step largely to the general exchange law of 1922. Under its terms the government may either acquire private land outright in return for stumpage or relinquish its land in certain units in return for private land in other units. The exchange work has just fairly been started. During the last fiscal year exchanges involving 42,185 acres were approved. There appears to be no good reason why the consolidation needed for management purposes can not largely be accomplished in the western states by this method.

In the eastern states where National Forests have been acquired largely by purchase under the Weeks Law, the proportion of privately owned land within the forest boundaries is much greater. Of the purchase units thus far established, 38 per cent have been acquired. In some few of the eastern forests, the consolidation of ownership has reached the point where satisfactory plans of management can be initiated. In many of the purchase units, however, the federal holdings are still too scattered to permit undertaking sustained yield schemes of cutting in any adequate fashion. The consolidation of federal holdings within the existing purchase units has for some years been the primary policy followed by the National Forest Reservation Commission. It should be one of the main objectives in our future purchase program. Last year

130,290 acres were acquired within the eastern National Forests. At this rate, a long time will still be required to consolidate the eastern National Forests sufficiently for effective administration.

In connection with further acquisitions by exchange or purchase, another point is worth noting. From the standpoint of management, the western National Forests, by and large, contain a large surplus of old growth timber. Our main problem there will be to carry some approximation of a sustained yield through the hiatus from virgin stumpage to second growth. We are short of young age classes in our stands. This would indicate the desirability, as far as practicable, of acquiring cut-over and second growth lands by exchange rather than areas of old growth timber. The ideal exchange project in the average western National Forest is one that will increase the acreage of forest growth that will be ready for cutting in 30 to 40 years. Very little land that fits this ideal is available; but as a general rule it seems wise to direct exchanges in the west as far as practicable toward acquiring cut-over and second growth areas rather than increasing the stock of mature stumpage. Other considerations, like that of maintaining a stable cash revenue from the National Forests, support this policy.

In the eastern National Forests, by and large, the conditions are reversed. Thus far, in acquiring about two and one-half million acres of land under the Weeks Law, the government has bought a total of about five billion feet of timber, or 2,000 feet to the acre on an average. In the eastern National Forests, in other words, we are long on cut-over and second growth land and short on merchantable material. In many sections a long time must elapse before much or any cutting can be done.

The eastern purchases have, of course, been based on the protection of the watersheds of navigable streams; and in the pursuance of that object I believe that a policy of buying larger areas of cut-over land rather than smaller areas of well timbered land has in the main been sound. Nevertheless, as our eastern National Forests are now taking more definite shape, are requiring a larger administrative organization, and are experiencing an insistent demand for timber from local industries and communities, I believe that greater recognition should be given in future purchases to building up management units with a more desirable distribution of age classes. The situation can, of course, be adequately balanced only by a slow period of forest restoration. We could not, if we would, buy enough timber to round out desirable management schemes with a proper stocking of age classes. It is not to be had in these relatively depleted regions.

In consolidating the National Forests for effective management, we should not overlook the necessity for eliminating dual administration of public lands within the same topographical units. The process of creating National Forests from suitable portions of the land in federal ownership is still incomplete. The timber and timber-growing lands forfeited to the government by the Oregon and California Railroad Company, in Oregon, are a case in point. A considerable part of them are within the boundaries of established National Forests, alternate sections scattered through the lands which the Forest Service is endeavoring to bring under systematic management. Adjoining the forest boundaries in various western states, and largely within topographic units already partially converted into National Forests, there are about four and one-half million acres of timber or timber-growing land now part of the unreserved public domain. Such lands should be added to the National Forests for many reasons, not the least important of which is the consolidation under one scheme of management of all of the timber-growing land within a natural administrative unit.

There are two viewpoints as to the policy of putting National Forest timber on the market. The first is that government owned stumpage should, as far as practicable, be held as a *reserve* supply, to be drawn upon for national requirements when the old growth timber in private hands has been exhausted. This viewpoint has often been expressed by private owners in the West who are liquidating large investments in timber lands or look forward to the time when they can liquidate such investments, and who do not relish even a small degree of "competition" from government holdings. In support of this view it is also urged, with considerable merit, that the country is now over-supplied with sawmills, that the production of lumber is frequently in excess of the demand, and that to the extent the federal government aids this process by putting its timber on the market, it will encourage over-hasty depletion of our timber supply and wasteful methods of utilization. It is also urged that the gain in stumpage values and through the closer utilization possible in the future would, financially speaking, more than offset the deterioration of old growth timber in the National Forests incurred through delay in cutting.

The second viewpoint is that the National Forests were not designed to function merely as reservoirs of old timber but should, as rapidly as may be, be converted into timber farms, both harvesting and producing crops of wood, like the normally operated European forest.

In support of this policy it may be said that it is not only poor forestry but bad economy for the public to suffer a loss from the deterioration of overmature stumpage, which is an appreciable factor in many virgin stands. It may also be said, and with good reason, that the best way in which the National Forests can aid in meeting the timber shortage is not by hoarding 20 per cent of the old growth timber in the country but by putting themselves in the most productive condition. As a matter of fact, if a sustained yield program is carried out effectively, there will be no appreciable diminution in the timber capital of the National Forests. Furthermore it is important, from the standpoint of the government, that the National Forests produce a substantial income and that the time of complete self-support should not be deferred indefinitely. This factor has many local bearings that can not be overlooked, including local needs for revenue, highways, and the like and the dependence of local communities on National Forest resources for industrial development or even continued existence.

Of even greater weight, in my judgment, than any of these considerations is the fact that only by actually cutting some timber can sound methods of silviculture and management be developed. Only in this way can the technical personnel on the National Forests be developed to function efficiently. Only in this way can a National Forest exert any educational influence in promoting sound forestry practice in its region.

The policy of the Forest Service is not to shove timber on the market at bargain-day prices. It is not to force the cutting of our stands, even of our old stands, regardless of economic consequences or of the effect upon the local lumber industry. On the other hand, we believe in the gradual expansion of timber cuttings in the National Forests as there appears to be a legitimate demand for stumpage, as satisfactory plans of management can be projected, and as competent personnel for the supervision of sales can be provided. In the course of 19 years of National Forest administration, the annual cut of stumpage has increased rather steadily until it is now about 1,125,000,000 board feet. This is still probably not more than one-sixth of the possible cut on a sustained yield basis. It will doubtless continue to increase at a rate of 10 or 15 per cent annually. At the present time, with the westward migration of forest industries in full swing, the Service is finding it difficult not to sell timber too rapidly. We are in danger of increasing the rate of cutting in advance of adequate management plans and our

capacity to provide competent personnel, and in advance of our ability to maintain high standards of silvicultural practice. The pressure to obtain National Forest timber makes it all the more important that a strong effort be exerted for developing sound plans of forest management and getting them translated from paper into live and effective work in the woods. This is daily becoming a more important phase of administration and is absorbing more and more of the thought and energy of our organization.

Our starting point in the National Forests, then, is that the cutting of old growth timber ought neither to be hastily pushed nor deliberately postponed; that the government should set an example of sustained yield management, necessarily broad and rough in character, rather than an example of timber hoarding; and that as reasonably satisfactory plans of management can be developed, cutting under them should begin with the emphasis always directed toward utilizing the over-mature and deteriorating stands first.

Our management plans are based upon these general policies rather than a strict adherence to any theory of regulation. Fine spun calculations of sustained yield are not possible from the data to be had nor are they regarded as necessary at this stage in the development of the National Forests. The Forest Service went through a period of attempting to develop refined and detailed schemes of regulation, following European precedents. They never got off of paper and into practical operation in the woods. The problem presented by our great overstocking of timber in all stages of maturity and overmaturity can not be worked out by that type of regulation. Nor is the data on growth and yield yet sufficient to justify it. We must deal with our management problem along broader lines and in more simple and workable terms. The time for refined regulation of the European type will doubtless come, but only after we have worked over our forests into more like a normal distribution of age classes and also after much more comprehensive growth and yield figures have been secured.

In the present pioneer stage, we are seeking rather to develop rough and ready plans of forest management, based primarily upon removing the stock of old growth timber and extending the period of its removal over the time that must elapse until the existing stands of young growth will become merchantable. The main purpose in most of these plans is to avoid a hiatus in timber cut after the old stock has been taken off and a disorganization of industrial and social institutions which depend

on a continuous output from a given unit. In some cases this principle can not be adhered to strictly because of the silvicultural condition of the old timber or local difficulties in securing its operation at a rate which will permit a sustained yield when the change comes from old growth to young stands. In many instances all that can be attempted is to control the rate of cutting so that we will have enough old timber to maintain operations until the young stands reach maturity, at which time a revision of the annual yield will be necessary. A scheme of logging under which the areas of old timber will be worked in the order dictated by their silvicultural condition, just as far as existing transportation facilities will permit, is always one of the most important features of the management plan.

The working circle, or unit of management in the National Forests, is laid out in accordance with topography primarily or a combination of topography with transportation facilities from the timber to the nearest point for its manufacture. In a typical western National Forest, this usually means that each major watershed is a separate working circle. The boundaries of the circle are often adjusted to the specific industrial or community considerations which are placed among the purposes to be served by the management of the unit. This is particularly true in the small working circles on a number of eastern National Forests, where maintaining established local industries or providing woods labor for rural communities are set forth as definite objects of management. We believe that as far as practicable the government should get down to the specific conditions and needs of the locality in laying out its schemes of management; and this factor has been given more and more weight as our general policy has developed.

A few illustrations will give point to these general ideas. The Row River watershed on the Umpqua National Forest in Oregon is typical of many situations in the West where the accessibility factor makes feasible only one good sized logging operation in a working circle. Here, on the west slope of the Cascade Mountains, a natural topographic unit contains 63,000 acres, averaging the second site class for Douglas fir. About 10,000 acres are in reproduction; about 12,000 acres contain dense young growth from 60 to 120 years old; while about 40,000 acres bear over-mature Douglas fir, much of which is stagnating if not actually losing in volume on account of rot. The total stand is about two and one-half billion feet, of which over two billion feet is overmature. The old stands have in fact a considerably smaller net volume than such

an area should produce at the end of a management rotation. A spur railroad 30 to 40 miles in length must be maintained and extended from time to time to provide transportation to a manufacturing point. This requires that logging be conducted on a fairly large scale.

The management plan is based on cutting the old and deteriorating timber as rapidly as possible while maintaining permanent transportation and a permanent industry. In effect this means spreading the cutting of the old timber over the period that must elapse before future operations can be carried by the present stands of young growth and reproduction. This requires cutting about 40 million feet a year for the next 50 or 60 years. Some of the regular formulae were tried, but only as experimental checks. Then we made up a list of the minor watersheds in the order of their silvicultural need for cutting, made a few modifications to meet the practical needs of logging development, selected the areas to be cut within the next ten years, and made an initial sale of about 360 million board feet accordingly. This is a rough and ready plan that would probably make a German expert in regulation shudder, but it fits the conditions. What we will be able to cut annually after the old stumpage is removed is not now an important consideration. It will, however, probably be more than we can cut at present.

In the Row River circle, clean cutting and consequently a cutting cycle as long as the rotation are necessary because the character of the Douglas fir stands precludes any scheme of partial cutting. In western yellow pine and similar types, this is not the case for young timber is mixed with the old. The Meadow Valley working circle in the Plumas National Forest of California illustrates this situation. Here again we have a natural topographic unit or basin, of 35,000 timbered acres, 80 per cent government owned, with a total stand of nearly a billion feet. Like most of the western pine stands it contains a surplus of old age classes and a deficiency of middle age classes. There is a corresponding surplus, from the standpoint of growing stock, of old, large trees that are making but little net growth. In other words, production in our wood factory is choked by the storage of finished goods.

In this case, we plan to hold all of the really thrifty, growing trees in the stand. From 5,000 to 6,000 feet will be left per acre in the government cuttings, equivalent to about 20 per cent of the total merchantable volume. This leaves about 790 million feet available for cutting in the first series of sales, or roughly 25,000 feet per acre. With the higher stumpage values that are inevitable in the future, a lighter cut will

undoubtedly be feasible—just how much lighter can not now be forecast with any definiteness. We are assuming, however, that 50 years' growth will increase the five or six thousand feet now left per acre to from 15,000 to 20,000 feet, which we believe will be sufficient to make future logging feasible. The patented lands, which are being cut more heavily than government lands, will not be ready for another logging at the same time; but will contribute something to the future yield from the working circle. Our general program therefore is to remove an average of about 16 million feet annually for the next 50 years and in the ensuing 50 years to remove from 8 to 10 million feet annually. At the end of that cutting cycle, the present poor distribution of age classes should be largely corrected and conditions will be ready for a more detailed and exact type of regulation. Under present conditions at least this unit will support but one logging operation of efficient size. Our immediate plan is then to offer this timber for sale at times when the operator who has built the improvements in the watershed will be in a position to remove the government stumpage, with contract stipulations that will limit the cut of government timber to about 16 million feet annually.

In this instance, as in the Row River working circle, the essential point is to spread the possible cut of mature timber over the period that must elapse before the cutting of young timber will be feasible. At the same time we will remove a surplus of old stumpage that must be taken out in order to put the forest into good growing condition. The key point of the plan is not a mathematical computation of the distribution of the surplus of old timber, but rather the very practical point as to the volume per acre which can reasonably be assumed as sufficient to support an efficient operation during the second cutting cycle, and the further practical point of permitting a present rate of removal that will be feasible under existing logging conditions and costs.

The two working circles which I have cited both have sharply defined topographic boundaries and are under the practical necessity of supporting but one fair sized logging operation, at least during the next 20 years or so. The management plan for the North Fork of Coeur d'Alene River in the Coeur d'Alene National Forest of Idaho has similar topographic features but different transportation and industrial factors. This watershed is tributary to a large manufacturing center on Coeur d'Alene Lake. Much of its timber can be operated in comparatively small units by river driving. In this instance the logging indus-

try is somewhat distinct from the manufacturing industry. Having determined that the working circle will support an annual cut of approximately 50 million board feet from its old growth stumpage, pending the time when its second growth stands become merchantable, logging units are selected from year to year, sometimes containing but half a million feet, and offered for sale under short-term contracts. These units may be operated by the sawmills themselves, by logging contractors, or by "gypo" loggers or local settlers working on a very small scale. The logs go down the river into the general log supply of Coeur d'Alene Lake. Where transportation factors permit such a distribution of sales and logging operations, the Service believes in handling its timber management accordingly because of the wider distribution of industrial opportunities afforded by the National Forest.

On the Harney National Forest in the Black Hills of South Dakota, the situation is still different but the same basic considerations are involved. Here we are dealing with a region of relatively easy topography, good accessibility, strong markets, timbered areas broken by parks, and a lumber industry of portable sawmills. Fifteen small mills are now operating within hauling distance of the Burlington Railroad and using the town of Custer as their base of supplies. A working circle has been laid out which comprises 167,000 acres but in which old fires, bug infestations, and former cuttings have reduced the present merchantable timber to about 110,000 acres. The boundaries of this working circle are partly topographic, but have been drawn primarily to include the area tributary to the settlements along the Burlington Railroad. The basic policy involved in this management plan is to maintain permanently within this area a regional lumber industry of small and relatively mobile units.

Although the stand is almost pure western yellow pine, there is an abundance of true growing stock in the form of immature trees. Timber matures on the average at about 16 inches in diameter and unless the stands are too crowded grows fairly rapidly until that size is reached. It is not a difficult matter silviculturally to leave a good growing stand on almost every acre, while taking out the mature, overmature and defective trees. Our silvicultural practice is based on a cutting cycle of 35 years, with a low yield in present logging, amounting to only 3,000 or 5,000 board feet per acre. Marking for cutting is determined by the thriftiness of the individual trees. A tree now 12 inches in diameter should be about 16 inches at the end of a cutting cycle of 35 years,

and hence mature. Practically the entire working circle has been cruised and we know approximately the number and size of the trees which will be left after the first cutting. Rough figures on timber growth have been determined chiefly by the use of an increment borer and indicate that a cutting cycle of 35 years is not too short.

In this instance again, the present stand of mature timber has been distributed over the first cutting cycle and indicates that we can safely remove about seven million feet annually. The producing acreage in the working circle is increasing and the rate of cutting can probably be increased in the second or third cutting cycles. For the present, however, we do not believe that an attempt to determine the future rate of yield is of any great importance.

Having fixed the amount that can safely be removed from the working circle as a whole, the next step was to allocate this cut by areas for the first 10 years. Dealing with portable sawmills and an exceptionally accessible country, it was possible to do this by small units and thus provide for the prompt cutting of the stands which most need it on account of overmaturity or defect. In drawing up this cutting budget, chances as small as 100 acres were segregated, while the average sale unit is less than 500 acres. The budget was drawn to guide the local officers in making their current sales as far as practicable in the order in which the areas were listed, and this is being done.

Because of their topography, the large stands of virgin timber, and the large mill type of forest industry, it has been necessary in the western National Forests to define working circles of relatively large size. In the eastern National Forests most of these conditions are reversed. The rule here has been to define small working units adapted to the requirements of little operators representing village industries or rural communities of woods labor. Take the White Mountain National Forest as an example. It has a gross area of 986,000 acres, within which the government has acquired about 441,000 acres. This forest is divided into 12 working circles, some of which still contain too little government land to justify a management plan. The key to the determination of a proper management unit is a workable area within which the situation as regards markets, woods employment for local people, and silvicultural treatment of the present stands are quite similar. Six management plans have thus far been approved and are in operation. The policy in formulating them has been to supply established industries and woods labor and also to develop diversified wood-working plants

in the immediate locality, along the lines of the New England toy manufacturing establishments, bobbin mills, shoe peg factories, and the like.

I may say in passing that the Forest Service does not believe that the limited amount of timber in the eastern National Forests should be utilized to any appreciable extent for extending the span of life of the large pulp or lumber mills which may still remain in their locality. Except where the necessity of salvaging timber, like blight-killed or blight-threatened chestnut, or other considerations beyond our control dictate otherwise, our management policy in the East seeks to develop and stabilize a large number of well distributed little wood-using establishments or units of forest workers. Most of the eastern working circles have been laid out primarily with this point in view.

For example, the Ammonoosuc working circle in the high mountains of the Presidential Range has an annual cut figured at but three million feet for the first five years. A considerable acreage of upper spruce slopes is excluded from cutting because of its recreation, scenic, and watershed protection value. This working circle is tributary to an old wood working plant at Whitefield, New Hampshire, which utilizes softwood timber for lumber and hardwoods for the manufacture of bobbins, taking both down to relatively small sizes. It is the industrial center of a New England village and depends on the National Forest for much of its timber supply. Supplemental small sales of fuel wood and pulpwood are made to utilize further material and provide labor for the local people.

The Saco River working circle now contains but 13,000 acres of government land and has an allowable annual cut of but one million board feet. This working circle is designed in part to supply the shoe peg mill at Bartlett, New Hampshire, which consumes from 1,000 to 1,200 cords of birch annually, together with the fuel wood requirements of the locality which amount to 800 or 900 cords annually. Fluctuations in the needs of the shoe peg plant are taken up in small local sales. There is not room for another permanent industry of any size and the Service has discouraged attempts to establish additional wood-working plants which would be in the market for government timber.

The Carter working circle in the Unaka National Forest of Tennessee illustrates similar relationships to the local industrial situation. This contains a horseshoe of government land around Stony Creek Valley, with its branch railroad which makes available a market for chestnut acid wood, tan bark, and like products at plants in several industrial

towns. Stony Creek Valley contains upwards of 3,000 people. It includes farmers of sufficient means to engage in woods operations as small contractors, small farmers who are unable to produce enough from their land to support their families, and a laboring class which depends upon farm employment and woods employment in various portions of the year. During the last few years, about 200 men in this valley have looked to the National Forest for employment. The demand for forest products, until recently, was greater than could be supplied; and management has consisted simply in determining a safe allowable cut, together with the salvaging of chestnut timber killed or threatened by the blight, and encouraging the disposal of this material through many little sales that would distribute the opportunity for industrial support among the small entrepreneurs and woods labor of the Valley.

It goes without saying that forest management on the National Forests is still in the rough and pioneer stage. We have an immense variety of conditions with which to deal. We are under the necessity of developing technical methods as we go. We can not withdraw these forest areas from use until schemes of regulation satisfactory to the technician have been completed; nor in our judgment is there need for such types of regulation under present conditions. Taking the two ideals of a sustained yield of timber products and a permanent and desirable type of forest industry and forest community, we believe that we should go right ahead under rough and ready plans of management dictated by common sense and by such growth and yield data as can be obtained. Constant improvement in these first management plans will, of course, be essential. The whole scheme is fundamental to the conception of National Forests. It is simply a question of using the best tool that we can devise for immediate requirements and then constantly seeking to improve the tool.

SILVICULTURAL PRACTICE IN THE UNITED STATES DURING THE PAST QUARTER CENTURY

By John F. Preston

U. S. Forest Service

In reviewing the progress of American silviculture during the last twenty-five years, it is necessary to keep in mind two things which have an important bearing upon the progress made. The first is the foundation upon which it is based, and the second is the status of silvicultural knowledge at the beginning and at the end of the 25-year period.

American silviculture as it has been taught to Forest School graduates is and always has been based upon European practice. Europe has practiced forestry for a good many years but the number of species has been limited, the range of climatic conditions is narrow, and the methods have been crystallized into fixed silvicultural systems. It was inevitable that silviculture by rule should be taught in American Forest Schools and that foresters in the early stages of development in this country should undertake to practice silviculture by rule in imitation of the art as practiced in Europe. As long ago as 1905 Alfred Gaskill[1] warned the profession against the danger of substituting empirical rules for silvicultural practice based on biological laws and intimate knowledge of local silvical factors. He said: "It is, of course, true that with the development of forestry in this country we shall learn to adapt our practice to local conditions, but the danger that to me seems so great is that with a faulty method we shall simply repeat the errors of the Europeans and do little to further the establishment of a real system of silviculture." I quote also from Dr. Fernow:[2] "We have to confess, we teachers of silviculture, that the knowledge we propound is of a most general character which fails to suffice when it comes to applying it in a given specific case. Silviculture is still an empirical art, relying upon trial and experiment to find out a *modus operandi*."

My review of the progress of forestry in this country up to this date leads me to assert that American silviculture has followed almost exactly the line against which Mr. Gaskill warned us in 1905. We have only in recent years begun to appreciate that the child born in our midst

[1]Suggestions as to Possibilities of Silviculture in America. Proceedings of the Society of American Foresters, April, 1916.

[2]Silviculture Applied to Virgin Forest Conditions. Proceedings of the Society of American Foresters; November, 1905.

could not be brought to full stature on patent foods bearing the label "made in Germany." The time honored formulae for handling woodlands, clear cutting and planting, clear cutting in strips, group selection and shelterwood, with few exceptions, have not proven satisfactory under American conditions, and yet we have substituted for them diameter limits, marking rules, volume control and other empirical methods which, over large areas, have produced results which may be called forestry but could hardly be termed more than crude silviculture. In measuring the progress of American silviculture, therefore, I am forced to record the fact that progress has been slow and that it is not yet distinctive of the genius of the American people. It is rather a slightly modified European product poorly adapted to our forest conditions.

The second outstanding fact is the lack of knowledge of species and types at the beginning of the 25-year period under discussion. Basic knowledge, without which there could be no progress, was the first essential in developing the art of silviculture in this country. Its absence at the beginning of the period is sufficient explanation and excuse for its lack of early development. During the period, however, there has been a considerable accumulation of knowledge of silvical facts. Admittedly, there is much to learn, but from the standpoint of practicing the art of silviculture—of applying the knowledge to the job of converting wild woods into productive forests—it is sufficient to justify greater progress than I am able to record. The United States Forest Service has been most prominent in laying this foundation of silvical knowledge. Its files and published literature are full of accumulated facts. Many foresters in private and state work and our teachers of forestry have contributed individually to this store of knowledge.

PROGRESS OF SILVICULTURE ON PRIVATE LANDS

Private land forestry began with the Bureau of Forestry and its efforts in advising private land owners in the practice of forestry. Several million acres of privately owned forest lands were examined by the newly graduated foresters of the country and in many cases bulletins were published giving the results of the examinations. In order to get something which the owner could understand and something simple of application these foresters fell back upon cutting to a diameter limit supplemented by marking rules. The foresters who made these reports did, I think, without exception, emphasize the importance of getting trained men to do the marking and nearly always recommended (often earnestly recommended) the permanent employment by the timber

owner of a trained forester. The diameter limit system and the marking rules were known to be a substitute for careful and skillful work by trained men on each individual acre of forest land. The system was intended for application in a general way over large tracts; something which could be applied in a more or less mechanical way. Theoretically, the application of the rules if properly carried out, would have resulted in a permanent or sustained yield.

The idea conveyed to the private owner by these efforts, in spite of the desire of the foresters who wrote the reports, was that silvicultural results could be obtained in a mechanical way. The idea that silviculture in practice meant the growing of more and better timber on each acre never seemed to soak in, and I am afraid it has made little progress with the private owner even to this day. Generally speaking, wherever the advice of the experts of the Bureau of Forestry was followed it was only in a very rough way. The logging superintendent followed a rough diameter limit which left a certain amount of young, thrifty trees for a second cut; the area was left in a productive condition but the possibilities of the soil for growing trees were not appreciated or made full use of.

Independent of the Bureau of Forestry efforts, was the development of private forestry in New England. Throughout the spruce type, lumbermen have been cutting repeated crops from the same land for a great many years. Some owners employed foresters at an early date and followed their advice to the extent of diameter limits, leaving at least something for a second cut. Planting of cut-over areas has been followed, to a limited extent, in New England, but, as I understand it, natural replacement has been sufficiently good to satisfy the owners, and perhaps the foresters, without resort to artificial methods.

A number of intensive forestry undertakings which promised to produce silviculture of a different sort should be mentioned. The Cornell School of Forestry undertook the practice of intensive silviculture through cutting and planting on the Tupper Lake tract in New York, but unfortunately the operation was stopped due to political complications. Dr. Schenk practiced intensive silviculture on small areas on the Biltmore Forest in North Carolina, but again the work was stopped through the discontinuance of the Biltmore Forest as a timber productive property. More recently silviculture as practiced on the Harvard Forest and on the property of the New Haven Water Co., in New England, are outstanding examples which have had a decided influence on

the trend of silviculture. The work which has been done in the Redwoods of California is notable, but is perhaps yet too new to properly classify; the plan, if carried out, will be the most extensive silvicultural operation on private lands in the United States. I should not fail to mention forestry as practiced by the Crossett Lumber Co., in Arkansas; by Henry Hardtner and the Great Southern Lumber Co. in Louisiana, or the Jackson Lumber Co., in Georgia and Florida as indicating the progress of silviculture of various degrees among private owners. I can not even attempt to give names of various companies in New England.

PROGRESS OF SILVICULTURE ON FEDERAL LANDS

It will be appreciated, I think, that the Forest Service, when it took over the National Forests in 1905, faced a difficult situation in undertaking to practice silviculture over the wide range of forest conditions which was found throughout the National Forests. The cut and dried practice of Europe was the only thing clearly understood by graduates of Forest Schools and there was an almost total lack of knowledge of the Western trees and types to use as a foundation for silvicultural practice.

The big job which the Forest Service tackled was organization; it undertook to put under administration and to protect from fire, the enormous areas of western National Forests. The main part of the job, at first, was not silviculture, but administration, and for that task Western men seasoned as cowpunchers and lumberjacks and fire fighters were needed and were used. In fact, the supply of trained foresters was entirely inadequate to meet the need for a bare skeleton force to handle the technical timber end of the business. The Forest Service soon realized that whatever silviculture was practiced must be done largely by untrained men with what help and inspiration the few Forest School graduates available could give. Some of the largest and most important of the earlier sales were marked by thoroughly trained men left pretty much to their own devices and the results obtained in many sales stand today as the finest examples of silvicultural practice which the Forest Service has to exhibit.

If there had been enough of those foresters to handle the growing timber sale business, the whole course of silvicultural development on the National Forests might have been different. American silviculture might have received at the hands of the Forest Service the nourishment it so sorely needed for growth and might even now be at least a husky youth instead of the pale, emaciated creature it is. But it is idle to spec-

ulate on what might have been. This history must proceed. The lack of trained men to handle the business forced the Forest Service to practice silviculture by proxy, just as the foresters in the old Bureau of Forestry were forced to do it on the private lands. Marking rules, diameter limits, and volume control were the means adopted to guide the hand which held the marking ax. Empirical silviculture as taught in the Forest Schools and as practiced in Europe took a new lease of life and the hope of developing American silviculture as an art distinctive of the genius of the American people, died.

I am not sufficiently informed as to exactly the kind of silviculture being practiced on these various operations to feel myself qualified to pass judgment upon them. Undoubtedly much good work has been done and a commendable start has been made. Wherever reforestation by planting is involved, it is my impression that the results are good and that the practice may be called intensive. On the other hand, where the silviculture involves work with the marking ax and the transformation of wild woods into something approaching fully stocked stands, there is little to give cause for congratulation. In a few places, silviculture has been recognized and employed with gratifying results but broadly speaking, only the crudest attempt has been made to improve the forest. Silviculture as an art, in the woods operations, is chiefly notable by its absence.

The Forest Schools have turned out a large number of graduates in the last 25 years, and the number of foresters in private employment or in private work has increased rapidly during this time. With a few exceptions, however, they are engaged as cruisers, land agents, logging engineers, or income tax experts, and but rarely do their duties include silviculture, except in the sense of silvicultural advice, marking rules, and empirical silviculture of the type of which I have been talking.

The natural influx of Forest School graduates could have been expected finally to have enabled the Forest Service to rise above the dead level of marking rules but unfortunately that source of supply was very effectually cut off by the deadening effect of the statutory roll. Be that as it may, the plan of silvicultural practice which has been followed by the Forest Service almost from the beginning is well set forth by Zon and Clapp in 1907.[3] After grouping the National Forests in accordance with the characteristic forest types, they state, "For each of these

[3]"Cutting Timber on the National Forests," by Raphael Zon and E. H. Clapp, Agriculture Year Book, 1907.

groups there has been worked out and adopted a definite plan of silvicultural treatment which is usually embodied in a set of marking rules for each individual timber sale within the given group and forest type." These marking rules are intended to be more or less fool-proof to be applied by rangers as well as forest school graduates who are considered to have an insufficient knowledge of silviculture and who could not therefore be trusted very far with the marking ax. The results of National Forest silviculture can be seen on practically every National Forest in the form of cut-over areas. I think I can truthfully say that the general average of silvicultural practice is good. If considered in connection with the limitations of the system which the Service was forced to adopt, surprisingly good results have been obtained. A certain average, considered reasonably satisfactory is a fair statement, I think, with reference to National Forest silvicultural practice; but the cut-over areas must be judged as *a whole;* they will not stand inspection on individual acres. That is the weakness of the system. It is empirical silviculture and the results must be judged accordingly; by its very nature it can not produce a finished article. It is, of course, very much nearer a finished product than the diameter limit silviculture as practiced on most of the private lands, although I have been told that the best of the private cutting compares favorably with National Forest practice. Unquestionably the Forest Service has practiced the best silviculture, considering both quantity and quality, which American forestry can show, but it must be admitted that, while it is perhaps the best that could have been produced at this stage, it is not leaving the National Forest cut-over areas in the best productive condition. I think this will be freely admitted by any member of the Forest Service familiar with the facts.

I do not want to be misunderstood. I do not condemn marking rules *per se.* In so far as they establish policy and control the general plan of cutting, they are useful and will probably always be used. Marking rules of this character carried into execution by foresters fully trusted and competent to exercise that degree of freedom essential to enable them to take full advantage of the opportunity offered to put the forest in the best silvicultural condition, are a help rather than a hindrance. It is only when the rules are used as a substitute for silvicultural talent or actually hamper its development that they are objectionable. Any system of cutting which depends for success upon more or less mechanical application of rules rather than upon the skill of the forester in the woods is bound to foster empirical silviculture.

If I could confine my history to a discussion of the development of knowledge and skill in the planting of forest trees, the report would be very much more flattering to American forestry. In this there has been real progress in private, state and federal activities. Not only has the technique of growing and planting seedlings of a large number of species been perfected, but real silvicultural experts are available in this field. The Forest Service has made equal progress with private and state forestry and it is a matter of congratulation to the profession that the development has been so evenly balanced. The states, particularly New York and Pennsylvania, have taken the lead in quantity production and in acreage planted. Statistics are available in several publications of the Forest Service and the states; limitations of time do not permit me to give details. The bulk of silvicultural activity, however, in American forestry has been, not planting, but the transformation of growing forests by means of the ax. In a weighted average the progress in planting can not overcome the lack of progress in the more important field.

STATUS OF "FORESTRY"

As a result of 25 years' work, forestry has emerged from its former status as a cause to its present status where it may be truly classed as a profession. Timber shortage has become a reality and the idea that timber can be grown as a crop has become pretty well established. Silviculture, however, has not progressed to the point of recognition; American silviculture is still the under-nourished orphan child it was 25 years ago. The country knows and the timber owners know that trees must be and can be grown if this nation is to continue to have a timber crop, but the private owners and, I believe that the profession of forestry, have not realized how much intensive silviculture can influence the growth of that crop. The present need is for skilled application of forestry knowledge to this job of growing timber—not a mechanical or empirical application of rules—but a skill born of intimate knowledge of trees and types and sites, aspect, slope, mixtures and diseases. In other words, we need a great number of real silviculturists. Where are they? Do the Forest Schools turn them out? Of course not. Has the Forest Service developed them? I mean, not theorists, but men who have made a reputation because of their skill in growing crops of timber. It must be acknowledged that the number of silviculturists developed by the Forest Service is very, very limited, and

I believe that the number who have grown up outside the ranks of the Forest Service is as great as those inside.

OUR OPPORTUNITY

I think we all agree that the outlook for real forestry in this country is exceedingly bright, and that the adoption of the principle by the larger private owners may be confidently expected in the near future. Recent national legislation opens new fields in federal and state forestry. The big opportunity, however, is the vast areas of privately owned forest lands which must be handled in a different way than in the past. The costs of carrying forest lands by private owners—taxes, insurance, fire protection, disease control, compound interest—everything is on a per acre basis. The debit side of the ledger is all figured out and charged to the individual acre. Foresters, during the past 25 years, have been largely overwhelmed and unduly awed by the tremendous sums which can be charged up as carrying costs to the individual acre, by the sleight of hand of compound interest. So absorbed have we been in these figures of carrying costs, that we have overlooked the possibilities of the credit side of the ledger—the yield which the forest can be made to produce by the skillful application of silvicultural knowledge. We should not, of course, cease our efforts to get carrying costs on a sane and reasonable basis; we should not hesitate to explain the fallacies and vagaries of compound interest; we should not fail to drive home the theories of sound forestry economics, but, our big opportunity lies in the practice of silviculture in the woods. We need more skill and commonsense application of silvical knowledge and principles in our cutting operations. We need, in short, some real silviculture in the woods and we can not have it except by the development of men who are known and honored because of their ability to get the maximum growth on each of these acres to which are charged up the carrying costs. Balance the costs against the high yields which our forests are capable of producing; that will put American forestry in an impregnable position. The private owner can be convinced of the soundness of forestry only by means of the skill of trained foresters in the woods. The time has come for intensive silviculture, and the recognition and the meeting of the need by the profession of forestry is the opportunity which is presented by the present status of forestry in this country.

FUTURE PROSPECTS

What can be said of the future prospect? I think it is encourag-

ing. Forest research has been given a new impetus through the establishment of Forest Experiment stations throughout the country. The basic laws of tree growth and their application to the problems of silviculture should gradually be unfolded and made available to the teachers and to the practicing foresters. The adoption of the idea of timber as a crop by private owners is going to force more intensive study of silviculture. The individual or the corporate owner who is attempting forestry for profit and is paying carrying charges on a per acre basis will soon learn to demand that each acre be made to produce its maximum in tree growth.

The pressure for better silviculture will come from the changed financial point of view of the timber owner once he understands the possibilities. Surely professional foresters will not be slow to respond to such a demand. More and more examples of fully stocked thrifty growing stands of timber as the result of the application of a new kind of silviculture will increase the demand for foresters who can produce such results. The McNary-Clarke legislation will stimulate the states to new activity and make possible, through better fire protection, much more careful attention to the problems of growing timber than ever before. Lastly, the United States Forest Service is not satisfied with the silvicultural progress it has made and is even now searching for ways and means of getting better results. "The wish is father to the thought." Silviculturists who successfully practice the art will, in the course of time, be recognized and duly rewarded in the federal and state services. I hope and expect to see empirical silviculture soon reach its ebb tide and be succeeded by the real thing. American silviculture, built on a foundation of thorough knowledge of American forest trees and forest conditions, adapted to the economic and political life of the United States and applied by American foresters, is destined to grow to be the biggest factor determining the success of forestry in America.

"SILVICULTURAL PRACTICE IN THE UNITED STATES DURING THE PAST QUARTER CENTURY"

Comments on Mr. Preston's Paper

By Ralph C. Hawley

Mr. Preston's article presents a depressing picture of the progress of silviculture during the last quarter century. Fortunately, his presentation is not an accurate portrayal of the situation.

The article is based on false premises, contains faulty deductions, and arrives at illogical conclusions. The feeling of the reader is that the article presents a warped view of silviculture in the United States and can not be accepted as it stands.

Silviculture in the United States during the last quarter century has made phenomenal progress—greater probably than ever occurred in any similar period elsewhere in the world.

As taught in American Forest Schools the subject is not now and never has been based on European practice. Its basis rests now, as in the past, on the principles of silviculture which hold irrespective of national and continental boundaries. Such principles can be taught and studied only as they are known, and improve in accuracy and scope with each decade. In the early days of silviculture in America, only the simplest principles were known.

Preston himself, in an article in The Timberman,[1] May, 1924, has furnished a good illustration of the universal usefulness of these principles. He recommends the following silvicultural operations:

Planting of poorly stocked areas.

Thinnings in middle aged timber.

Removal from the felling areas of worthless species and defective trees.

Special operations for control of white pine blister rust.

Disposal of slash.

Partial cutting of mature and overmature stands.

Will Mr. Preston deny that the simple silvicultural principles which justify these operations were known long before 1900 and can find general application?

The development of silviculture in the United States followed the

[1]Forestry Practice and Possibilities in North Idaho, by John F. Preston, The Timberman, May, 1924, pp. 49-50, 156-160.

natural and logical course. The first foresters did not fall into the error against which Gaskill[2] warned. They saw early in the period the need of definite scientific knowledge of species and types and set about its acquirement. Since years of effort are required to secure this information for even a single species the early cuttings were made according to the judgment of the silviculturist as to the best application of the simple principles of silviculture to the conditions encountered.

From the mistakes as well as from the successes, valuable lessons were learned. At the end of the period the sum total of acquired knowledge is impressive. Such reports as Pearson's "Natural Reproduction of Western Yellow Pine in the Southwest," Hoffman's "The Natural Regeneration of Douglas Fir in the Pacific Northwest" and Bates' "Forest Types in the Central Rocky Mountains as Affected by Climate and Soil," each representing years of investigation, are scientific achievements of the first order.

We may agree with Preston that the actual practice of silviculture over the country as a whole has not kept pace with the acquirement of knowledge. On private lands which constitute 79 per cent of the forest area only scattering examples of silvicultural practice exist. This is not surprising, since with abundant timber supplies, the time was not ripe for the private owner to apply silviculture.

On the National Forests the practice of silviculture is general and by the exigencies of the situation began in advance of the gathering of basic knowledge. Those of us outside the U. S. Forest Service feel proud of what this organization has accomplished within a few years and in spite of formidable obstacles.

Preston laments the control of cuttings on National Forests through marking rules, diameter limits and volume control, and the relegation of the actual marking to unskilled men, blaming this situation upon the asserted European basis of silviculture. His plea for the employment of more skilled men in the woods is one of the best points in his paper, yet attributing the situation to a European background is unwarranted. Factors of an economic nature, outside of silviculture and largely beyond the control of the Forest Service, were causative. The idea that silviculture for finished results must be applied in the woods by skilled men is of old European origin. True? Fundamentally so; but not new. Foresters throughout the world continually strive to attain this ideal. The limitations of time, cost and bureaucratic control

[2]"Silviculture Applied to Virgin Forest Conditions." Proceedings of the Society of American Foresters. Vol 1, pp. 62-69.

function the world round to make difficult and long deferred its attainment.

Preston goes a step farther and deduces from the Forest Service subservience to the marking rule system, fatal consequences to the whole country. He says "the hope of developing American silviculture as an art distinctive of the genius of the American people died."

I deny the accuracy of that statement. The U. S. Forest Service has the ability to change policies if changes become essential. Furthermore, Preston overlooks the fact that silvicultural practice on private lands is independent of the U. S. Forest Service. Already the best illustrations of intensive silviculture in the United States are found on private lands.

The alleged subservience of the Forest Service to marking rules will never prevent the ultimate development of both crude and intensive silvicultural practice on private lands just as fast as such operations become profitable. There is today abundant ability in private employ to develop the practice of silviculture in a way adequately expressive of the individuality of our people.

Silviculture has been practiced to a very limited degree on state lands. An exception should be made in the case of planting, including the development of nurseries to supply stock for use on state and private lands. The reasons for the slow development of silviculture on state lands are in most cases absorption in the business of acquisition and organization, lack of timber to sell and shortage of funds for cultural operations.

Looking forward to the coming quarter century, it may be expected that the acquirement of basic knowledge will continue on an enlarged scale, stimulated by the increasing number of men engaged in silvicultural research.

Silviculture on National Forests, already established with strong financial backing, should improve in quality, though not necessarily in intensity of application. Economic conditions, except in restricted areas, are not likely to change so radically as to make advisable intensive crop management in contrast to extensive crop management on National Forests.

The practice of silviculture on private lands is starting gradually, using simple methods. If, by the end of the next 25-year period, such measures are in use by the majority of private owners, the achievement will be most satisfactory.

The factor which has and will hold back the application of silviculture on private lands is not lack of men capable of growing crops of timber, nor failure of private owners or foresters to realize how intensive silviculture can influence production, but rather economic conditions which have not yet justified the general practice of silviculture.

It is true that the U. S. Forest Service in charge of 89 million acres of the less productive and more inaccessible forest lands has been able to practice silviculture for the last 15 years. Why were they able to do this? Because, first, the National Forests contained a surplus growing stock and hence financially profitable cuttings could be made, and second, by keeping stumpage prices in harmony with more or less severe restrictions in timber sale contracts, timber could be sold at prices which enabled the purchaser to cut and market timber at a profit. In other words, the people of the United States, the owners of the National Forests, have been paying through lessened timber sale receipts most of the costs of silviculture.

The private owner with few exceptions, although holding the more productive and less inaccessible forest lands, has as yet refused to pay the costs of silviculture. This may be due either to deficiency in the growing stock which prevents the securing of a regular annual income, or if an ample growing stock exists the margin of profit may be too small to justify the costs of silviculture, or finally and most likely the owner does not desire to invest his money in growing timber crops and thereby reduce his present profit.

While in theory a shortage of timber exists or will exist in a few decades, yet except in certain special products, this shortage is not generally apparent and will not be so long as virgin timber from the west coast floods the markets of the country.

The failure of the private owner to practice silviculture today is due to this situation and not to the lack of silviculturists. More silviculturists are available today than can secure employment in such positions. Preston overemphasizes the importance of what he terms real silviculturists with big reputations and underestimates economic conditions in their relative effect on starting the practice of silviculture on private lands.

He decries the lack of men in and out of the Forest Service "who have made a reputation because of their skill in growing crops of timber." How illogical to expect this! Of course such men do not exist in abundance as yet. Sufficient time has not elapsed. It requires per-

manent contact for one or two decades with the same forest in order to become an expert in the application of silviculture. How many men have had this opportunity?

Another misconception is that the standard silvicultural systems, such as group selection, shelterwood, clear cutting with natural regeneration, clear cutting with artificial regeneration, first named in Europe, can not be employed under American conditions. It is now recognized that these systems are subject to infinite variety of application and may grade imperceptibly from one into the other in a continuous range which embraces the entire field. Illustrations can be found in the United States today of all the more important systems and they will multiply as silvicultural practice increases.

The Forest Service continues to use some of these methods in their cuttings. For example Weidman,[3] for western yellow pine in the Northwest says: "Since the beginning of timber sales on the National Forests 15 years ago, the silvicultural system generally used in western yellow pine has been characterized by a selection method of cutting." Dunning,[4] in discussing cutting in the sugar pine-yellow pine type of California, advises both shelterwood and selection cuttings to fit different conditions.

Standard silvicultural systems are used in spite of the fact that the Forest Service is cutting virgin timber of great age, thus working off their surplus of overmature timber and preparing to grow crops of second growth. Silviculture as it starts today on the biggest part of the forest lands of the United States, namely, those east of the Great Plains, will deal with second growth stands which lend themselves more readily to definite methods of crop management than do virgin stands.

It is essential to have the right perspective. Our silviculturists should possess a viewpoint sufficiently broad to enable them to assimilate and utilize knowledge developed in any part of the world. In many instances there is a greater similarity, silviculturally, between species and types growing in two different continents than between geographically contiguous types.

PRESTON'S REPLY TO HAWLEY'S COMMENTS

Professor Hawley refuses to acknowledge the facts. He says the picture presented is depressing but "fortunately, his presentation is not

[3] "Forest Succession as a Basis of the Silviculture of Western Yellow Pine." Journal of Forestry, Vol. 19, pp. 877 to 885.

[4] "Some Results of Cutting in the Sierra Forests of California." Bull. 1176, U. S. D. A. 1923, p. 25.

.....accurate....." It would be a much more pleasant task to congratulate the profession on the wonderful progress made and shut our eyes to the real situation, but that isn't the way to make progress. Hawley admits the lack of progress of silviculture in the woods and the failure of the profession to develop silviculturists. That is the important point. The only difference between us, therefore, is the analysis of why this is so. I contend that the profession has not made use of the opportunities which exist and that part of the trouble is the failure of our teachers of silviculture to impress the students with the difference between the form and the substance—the difference between the European silvicultural systems and the fundamentals of the practice of the art in the woods.

The profession has failed to register, silviculturally, in private forestry and only faintly in federal forestry. Hawley admits that, but explains it by saying it is because economic conditions are not yet ripe. That is the time-worn excuse but I feel sure that it will not satisfy most foresters as sufficient. A trip in the woods anywhere (with the few exceptions already noted) where forestry is being practiced will convince any doubting forester that the possibilities of silviculture, with all existing economic limitations considered, have not been scratched. The situation is nothing less than a challenge to American foresters.

THE BOGEY OF COMPOUND INTEREST

By Ward Shepard

Assistant Chief, Branch of Research, U. S. Forest Service

Foresters have long promulgated the doctrine that timber crops, from seed to maturity, accumulate all charges—such as cost of planting, protection, taxes, etc.—at compound interest. These charges, so compounding, mount up to such formidable figures that they are among the most frequently urged "economic" reasons against timber growing. The argument is that a tree takes 50 or 75 or 100 years to reach maturity, that it has meantime yielded no salable commodity, and that the total investment in the tree must be reckoned at compound interest because the return is deferred until the tree is cut; for if the same amount of money had been invested in securities yielding annual returns, then the returns could have been reinvested each year, thus compounding.

The transparent simplicity of this argument has gone largely unchallenged by foresters and has been warmly embraced by many people who, for various reasons, do not want to bother with timber growing.

The discussion of compound interest has been largely academic and has neglected to consider the actual conditions under which timber growing is feasible. In order to make my argument clearer I shall first state my main conclusions:

1. Sustained yield (i. e., continuous flow of income) is necessary in the great majority of private timber-growing enterprises.

2. Under sustained yield forestry there is no compound interest. The reverse of this is that where compound interest does apply, sustained yield can not at present be obtained.

3. A considerable proportion of private forests can, with enterprise and skill, be put on the sustained yield basis at the present time.

The academic proponents of compound interest always start with the Simon-pure classic example of the courageous man who in his youth altruistically reforests or afforests a barren plain and in his old age discovers himself bowed down with a vast accumulation of compound interest. As an exercise in logic this reasoning is excellent for young students who must not be confused with complex premises; but as a realistic exposition of the financial aspects of our present forest problem it is over-simple and largely illusory.

In the first place any theoretical doctrine must be tested in the light of the practical conditions under which it will be applied. In the United States these conditions are partly determined by the classes of ownership of timberland which in turn determine the purposes for which the land is held. These classes are roughly as follows:

The public (federal government, states, etc.) own 97,000,000 acres.

Farmers own 150,000,000 acres.

Lumbermen, timber holders, large estates, etc., 223,000,000 acres.

Compound interest will never be a deterrent against large-scale timber growing in the public forests. Interest is ordinarily regarded as a reward to the individual who instead of spending all his income (income in this case meaning goods rather than money) sets some of it aside for further production, thus benefiting others by increasing the world's supply of goods. But the very purpose and function of the state is to have an eye to future generations as well as the present and the state, as representing the collective will, can not expect to reward itself in the present for providing benefits for future generations.

To charge compound interest on public forests would be analogous to charging compound interest on the Navy between wars, or on highways, or in the public school system, or any other great basic institution of our civilization. The chief financial concern of public forests is to balance the budget, and as they work toward sustained yield and full utilization this object will be achieved. Meanwhile the deficit is paid out of current taxes, and I do not believe anyone would seriously propose compounding this deficit until it is wiped out. Such a charge would be of only academic significance, except probably in fixing the price of stumpage to avoid unfair competition. Thus on more than one-fifth of our forest land at least compound interest is not rationally chargeable.

The second large class of timber land is in farms. Unfortunately most farm woodlots are being "mined" and there are properly speaking no carrying charges except taxes and depreciation. But suppose a farmer starts out to handle his woodlot by forestry principles. The average farm woodlot so handled will be managed on the selection or partial-cutting system. Certainly the peculiar advantages of the woodlot to the average farmer will not be reaped by clear-cutting—such advantages as winter work, small regular income, steady yields of farm timber, diversity of crops.

If the farmer, or anyone else, goes out and plants a woodlot and waits 50 years for it to mature he would no doubt, financially speaking,

have to reckon compound interest on costs and such carrying charges as taxes. How far this will act as a deterrent to planting remains to be seen. Farmers and estate owners who plant woodlands may be moved by many motives that hidebound "economists" do not recognize in the scheme of things. They may love the soil and what grows from it. They may like trees. They may want to provide a dowry for their children. They may be moved by a sentimental, carefully-hidden concern for the next generation which, it is true, "never did anything for them" but which, nevertheless won't invite itself into the world. They may simply have that stubborn creative instinct that leads so many men to useful activity. What I am driving at is that people who plant trees are willing to take chances with taxes and fire and even compound interest in the faith that somehow their venture is worth while. And in the case of farmers in general I do not believe that straight economic motives or an immediate balancing of the budget will be the determining motive in the better handling of woodlands. What is needed among these owners is education in forestry ideas and cheap planting stock.

What is the main issue of our forest problem? It is to get forestry (i. e., fire protection and decent cutting methods) into effect on something over 200 million acres of land in private holdings not on farms. If forestry is put into practice on these lands it can by and large only be, in my opinion, on the basis of sustained yield. Large timberlands will be handled as commercial projects demanding a steady flow of revenue and profits. As natural-growth timber disappears, as prices rise, lumber manufacturers and wood-using industries will either be forced to grow timber on the principle of sustained yield, or to buy it from other people who grow it, or to go out of business. These "other people" will be either farmers or landowners who are more likely than not to get onto the sustained yield basis.

The trouble with the classic expositions of the theory of compound interest as applied to timber-growing is that they all start from the basic assumption of the bare soil. This process of reasoning has then been applied abstractly to *all* our forests regardless of whether they were restocking naturally and whether they could be placed on sustained yield. As a matter of fact it is inconceivable that timber-growing on a large scale ever began in Europe with nothing but the bare soil. Thousands of people did not go out and reforest millions of acres of denuded land, and then patiently wait for a hundred years for it to mature. What must have happened in Europe is what is happening in America today; in favorable localities individual companies who can get the right com-

bination of mature timber and young growth to maintain a perpetual, annual cut of a given amount are going into timber-growing. This will be a gradual process, accelerating as natural growth timber disappears and becomes higher priced. And it is the process by which most forestry, outside of farm woodlands, will come about. Another method of starting timber-growing is that of Sweden where owners are compelled by law to maintain their forest land in a productive condition. It is interesting to raise the question here whether these owners are being bankrupted by compound interest under this legal requirement or whether it does not rather expose compound interest as a largely fictitious academic concept.

Compound interest as a really significant practical problem, then, arises in connection with sustained yield holdings. A forest handled on sustained yield is a tract of land on which the periodic cut (say the yearly cut) equals the periodic (say annual) growth. Is compound interest actually chargeable in a sustained yield operation?

A permanent forest industry is exactly like any other business enterprise. It must have a permanent source of raw materials and a continuous output of profitably salable commodities. Lacking either of these, it is not permanent. A forest industry to be permanent must either grow its own wood or have access to wood that is grown. Otherwise it will disappear when the timber disappears.

For the sake of simplicity consider the case of an industry which must grow its own timber or go without. Then it is obvious that a forest large enough to grow the necessary timber is an integral and irreducible part of the industry as a permanent enterprise, just as the power plant or gang-saw is.

A going sawmill has found, for example, that counting its holdings of mature timber which will last for some years, it can buy up enough cut-over land containing young growth to keep the operation going permanently. By the time the old growth is cut out, the young growth will be reaching maturity. By practicing forestry the land will be reproduced as it is cut over and there will thus be established a permanent cycle of cutting and growth.

The whole operation, sawmill and forest, must be visualized as an entity. It is one plant, a wood-growing and a wood-manufacturing plant. In particular the forest must be visualized as an entity. Foresters, in thinking of compound interest, split the forest up into individual acres. This particular acre, they say, won't yield usable products for 50 years; therefore we must assess and compound against this acre its

proportionate share of the carrying charges of the whole forest on a per acre basis and in addition the particular charges against this acre for reforesting, etc. And so they go from acre to acre.

If we look at the forest as a unit, we perceive that it is in essence a cellulose-making entity. Its energy is given to growing wood. Every tree grows. But for human use we can't strip the annual growth of cellulose from each tree in our sustained yield forest. We must each year cut in the form of mature trees, that can be sawed into boards, the *equivalent* of the wood that is laid down that year on *all* the trees. We concentrate the year's cut, which represents the year's profit, against a few trees; though in reality that profit was earned by all the trees in the form of the wood they all grew. With equal logic and necessity we are forced to concentrate the *total year's carrying charges* against those same few trees that form the annual cut.

There is here, it seems to me, a confusion in the academic theory between the tree as *capital* and the tree as *crop*. A forest is not bare land. Bare land will not produce wood any more than a factory without machinery or raw materials will produce commodities. A forest is land plus trees. We might compare the soil to the factory building, the trees to the machinery, and the food supply of the soil, the water, and the sunlight to the raw materials. Now to produce from this factory the commodity wood, we must have both the soil and the trees. The trees as machines produce wood by growing. When these trees are ready to cut they become crop or commodity. If all the trees in the forest were crop instead of capital, the large percentage of them that die by suppression or disease would (according to the interest theory) accumulate compound interest forever because they cost money to start with and never produce any return. The compound interest theory has led to the idea that each growing tree is an unfinished product in process of manufacture from start to maturity. The finished product or crop of the managed forest is in reality the wood that is cut each year. These small trees as they grow are capital, and not a crop until they are ready to cut. They are therefore yielding a return (considering the forest as an entity) in the shape of the trees that are cut each year. They yield a return in the same sense that the power plant of a factory produces a return, though the actual commodities are produced in other parts of the plant and shipped from the shipping room. It is an unwarranted and illogical assumption that carrying charges must be allocated against *places* (i. e., acres) instead of against *products*. And the product is the periodic cut, which represents the whole growth for the period.

Unless we allocate the annual charge against the annual cut, I ask anyone to propound a system of cost accounting that will allocate the costs in the only other possible way, namely, against the individual acres and the individual trees of the entire forest. The absurdity of attempting to do this outside of German text books becomes a patent farce in the case of a selection forest. Here you have trees of all ages growing side by side. You go through each year and cull out the big ones. If you don't assess all charges against the annual cut, then you must assess them against each individual tree according to its size, age and cost. Or if you compromise with the Simon-pure academic principle, you must start a vicious, unending circle of compound interest roughly allotted to all trees that are not cut.

The confusion between timber as capital and timber as crop can be illustrated by destructive logging. Destructive logging cuts all timber that can be sold and usually destroys the rest by fire and logging machinery. From the economic and social standpoint it is an illegitimate enterprise because it not merely cuts the crop but destroys the forest as producing capital. It wrecks a going plant and renders it unproductive. The entire investment must then be amortized. It therefore follows as the converse that all money spent in sustained yield forestry for keeping the forest permanently productive—such expenses as reforestation, protection, and administration are *charges for upkeep of capital* by which alone a crop can be produced. Depreciation is a current cost that must be met from current returns. In a sustained yield forest these current returns come from the annual cut.

If this reasoning is right, then the theory of compound interest disappears so far as sustained yield forests go: and *ipso facto* it disappears from our main immediate forestry problem, for if we are to have private forestry it must be, by and large, on sustained yield forests. This is the same as saying that compound interest applies to those forests that can not be put under sustained yield.

A company that has or can get both mature timber to keep it going and young timber to be growing up in the meantime has, it is true, a fiscal problem but it is not the problem of compound interest. The problem is this—will the annual returns pay all the annual charges—interest, taxes, planting, protection, etc. and leave a sufficient profit to attract the necessary capital? If so the company will probably be losing money by *not* going in for sustained yield.

In the first place the price of lumber is partly determined by the carrying charges—interest, taxes and protection—on large blocks of ma-

ture timber held for future cutting. These charges diminish as the timber is cut. As they diminish, the savings thus made could be applied to the carrying charges of the young forest. For if the price of lumber is high enough to permit meeting carrying charges against large blocks of mature timber, they are high enough to permit similar charges against young growth. And of course the charge against merchantable stumpage is much higher than that against unmerchantable stumpage.

If the old timber is cut without any attempt at starting a new crop, rapid and heavy depreciation occurs, for the whole operation must be amortized. This depreciation will be wholly avoided by sustained yield.

The fire protection system on old growth timber can, without proportionately increasing the expense, be applied to the young timber.

Taxes likewise under destructive logging will continue on the denuded land, or will be transferred to the remaining timber. If, however, the cut-over land reverts to the State, the public will be "holding the sack," for it will lose the taxes and be saddled with the liability of idle land.

All these instigating factors reenforce the conclusion that forest destruction is enormously costly not only to the public but to the industrial interests responsible for it.

It remains to examine briefly the physical limits within which sustained yield can be practiced. We have some 80 million acres of non-restocking land which must be counted out. The rest of our forest land is divided pretty evenly between old-growth forest (138 million acres), second-growth of saw timber size (114 million acres), and small second-growth (136 million acres).

We must admit, even though these figures may be only rough approximations, that we have a pretty fair assortment of age-classes to base sustained yield on. Regionally the acreages are as follows, as given in the Capper report:

	Saw timber Million acres	Young growth Million acres	Non-restocking Million acres
New England	11	9	6
Middle Atlantic	12	11	6
Lake	31	13	21
Central	30	24	2
South	87	32	35
Rocky Mountain	41	15	5
Pacific Coast	45	6	7

The South and the Pacific Coast States, by reason of their large areas of saw timber, are particularly fitted to go into sustained yield. Large holdings in these two regions are also favorable factors permitting a company to transfer its carrying charges from old to young growth, as the saw timber is cut off.

The Middle Atlantic and New England States are characterized by small holdings, although there are of course large ones as in Maine. The disadvantage of small holdings is, however, offset by high stumpage prices and nearness to markets, both favorable factors for sustained yield.

In the Lake States the factors favoring sustained yield are complicated by the large percentage of denuded land, but here again nearness to market saves large freight bills and increases stumpage values.

The Rocky Mountains, on account of the low productivity of their lands, are the least favorable of our forest regions for profitable forestry. Fortunately, however, 52 out of the 61 million acres of timberland in that region are in federal ownership and will be kept productive.

The central hardwood region will, as I have said before, be influenced in reforestation by many considerations besides "compound interest" and profits.

Not only is there a vast acreage of young forests as a basis for sustained yield, but there is a marked concentration of ownership in large companies, many of them financially strong. In 1910 three corporations owned 11 per cent of all the privately owned timberland in the United States. In the Lake States, the Southern Pine region, and the Pacific Northwest, in that year, according to the Bureau of Corporations, 48 per cent of the privately owned timber (which of course meant most of it) was controlled by 195 owners. From the standpoint of strategy these owners should be the main point of attack for converting to sustained yield.

Foresters ought, it seems to me, to be emphasizing the favorable chances for sustained yield in these various forest regions. These second-growth forests demand, not merely fire protection, but intensive management, such as weedings and thinnings. Once a company goes in for sustained yield, it ought to devote as much money as it can spare to really intensive management of its young forests instead of the mere "conservative logging" that foresters have timidly advocated.

The fallacy in much of the thinking about costs of reforestation is shown by the following quotations. They are by the same lumberman,

in the same issue of a trade paper, but tactfully separated by one page:

"Our present tax systems are such that I can not see how any individual company can hope to undertake the growing of timber as a crop. * * * The state and the nation are the only two agencies that can reforest, except possibly some redwood operators in California."

"The ———————— mills announce that recent timber purchases insure continuous supply at the present rate of production for another half century. * * * Operators who mean to stay in the lumber industry must buy their timber reserves while forest areas are to be had. In a very few years it will be too late to buy virgin stumpage."

The peculiar susceptibility of young forests and the entire immunity of old ones to the ravages of compound interest are thus demonstrated.

FOREST PROTECTION—DISEASES

By E. P. Meinecke, Pathologist

Office of Investigations in Forest Pathology, Bureau of Plant Industry, San Francisco, California

EARLY HISTORY

The history of Forest Pathology in the United States dates back to the years 1887 and 1888 when the first articles on tree diseases appeared in the Reports of the Department of Agriculture. They represent the first genuine attempts at scientific study of the subject in this country. The year 1899 saw the creation of the Mississippi Valley Laboratory from which emanated a number of papers on tree diseases. Its field of activity soon broadened out to include the study of other plant diseases. It ceased to function in 1907 when the present office of Forest Pathology was inaugurated in the Bureau of Plant Industry. This year marks the beginning of systematic investigation of the rôle of diseases in the American forests.

Forest pathology as a science did not originate in this country. It was brought to the United States from Europe by students of Robert Hartig. It was soon found that the same principal group of wood-destroying fungi is active in the forests of the United States as abroad. The well-known European species of fungi were described in their behavior on American hosts, and new indigenous fungi were added to the list. The investigations were practically altogether confined to biotic agencies, to their description and to the tracing of their life histories.

The pathological side was little considered. The effect on the individual tree seemed less important than the mycology of wood-destroying fungi, supplemented by the study and detailed description of the destructive effect on the wood itself on the pattern of Hartig's classical studies and methods. This phase of development in forest pathology concerned itself with the cytology of decay, or at least with the microscopical changes brought about in the cell walls of the wood by destructive fungi. It did not consider the effect of the disease on the tree itself as a growing and functioning unit, and to the present day morbid physiology of the forest tree is a field which has remained almost virgin.

The only exceptions in which pathology in a truer sense of the

word has found an early expression were investigations on certain tree killing fungi, prompted by the devastating invasions of eastern forests by the white pine blister rust, and the chestnut bark disease. Research on the former soon resulted in a workable system of control and protection. In the case of the latter the recommendations made on the basis of exact studies were put into practice with inadequate funds and at too late a date to preserve the chestnut stands as a commercial asset.

One of the first larger undertakings of the office of Forest Pathology was the extension of a pathological survey, or rather a survey of disease-causing organisms, from the east to the recently organized National Forests of the west. This country-wide survey soon showed that some of the well-known organisms of Europe and the east were ubiquitous wherever they found congenial hosts, but also that the newly explored regions harbored their own, and in many cases very harmful, pests. The interest in fungi remained in the foreground. A new factor was added to these in the west with the mistletoes, particularly of the genus *Razoumofskya,* which in the western coniferous forests assume a significance not known in the east. Here also the type of work was mainly descriptive.

Though at an early period the relation of disease to the forest was glimpsed it commanded little more than academic interest as long as professional foresters themselves failed to see the bearing that the presence of highly destructive agencies in the forest must have on their own problems. It was not until the beginning of the last decade that the Forest Service began more acutely to feel the need for intensive work on tree diseases, which culminated finally in the request that consulting forest pathologists be attached to its Districts. The first forest pathologist was appointed in 1910 for District 5 and later also for District 4. In 1911 pathologists were assigned to Districts 1 and 3. District 6 was provided for in 1920. At the present time Districts 1, 2, 7 and 8 are without consulting pathologists.

SYSTEMATIZED RESEARCH

The close contact of the consulting pathologists with the practical field work of the Districts brought with it an immediate and complete reversal in objectives. Without neglecting the fundamental field of descriptive mycology the center of interest shifted to the pathology of the forest and its direct and indirect relations to forest economics and to forest management. More and more the emphasis was laid on the

necessity of making pathological research subservient to the practical aims of management.

For a fruitful cooperation with forestry it was necessary that both its immediate needs and its ultimate objectives were fully understood. There could not be any doubt from the beginning that the principal aims of forestry in the United States as represented by the Forest Service were first the harvesting of the overmature timber in its possession as a means both to turn into cash such values as had accumulated in past centuries and provide room for young and supposedly more productive stands. The accomplishment of this first step hinged on the chance of a timber sale, preceded by an inventory of the goods for sale. Against the apparent volume stood the unknown quantity of cull. The first pathological investigations on a larger scale were directly concerned with the determination, by species, of the cull per cent of representative areas in different parts of the pine forests of the Sierra Nevada. The result was the substitution of an experimentally determined and fairly accurate cull per cent for the purely empirical one used hitherto. Out of the same series of studies was born the recommendation that apparently unmerchantable trees and snags be felled under the terms of the sales contract, for the double purpose of utilizing such merchantable portions of wood as they may contain and of eliminating carriers of disease from the cut-over area with its young timber. The felling of snags in addition removed a serious menace in case of forest fires. The recommendation has since been incorporated in timber sales contracts as a standard clause. The measure which originally was adopted mainly in the interest of protection has proved its economic soundness. In California where the clause has been more strictly enforced the salvage accruing from the merchantable parts of supposedly useless trees is more or less equivalent to the cost of administration on typical timber sales. From the administrative point of view the chief advantage lies in the elimination of friction between the Forest Service and the purchaser.

In the semiarid mountain forests of California clean cutting leaves, as a rule, little chance for the establishment of reproduction. It is common practice on Forest Service timber sales, therefore, to leave unmarked and uncut a certain percentage of larger but thrifty trees as a nucleus for the next stand. While good silviculture demands that only sound trees be carried forward it is not always easy to distinguish diseased trees from sound ones without the help of definite symptoms. A number of these, particularly for some of the principal wood-destroy-

ing fungi, have been worked out and have become of material assistance in marking. The prevalence of mistletoes throughout the western forests has from an early period on led to an attempt to protect the young stand by intensive marking of old infected trees. That mistletoes must have a very deleterious effect is evident at first glance, and more detailed studies, particularly on Douglas fir, larch, yellow and lodgepole pine in the northwest and on yellow pine in Arizona, have confirmed this observation. How far this effect actually goes is still an open subject for future studies.

In the Southwestern District the problem of brush disposal after cutting has been investigated from the pathological point of view. The increasing cost and other undesirable features of brush disposal by burning have rolled up the question whether the same object could not be attained by hastening the natural process of decay. A study of the saprophytic fungi which are principally active in the brush and débris left on cut over areas has shown that the conditions prevailing in typical brush piles are unfavorable to their growth and that the material disintegrates much more rapidly when the tops are pulled and the smaller stuff scattered. This method is now widely applied in the Southwestern District, and a similar study is under way in California.

Without underestimating the assistance which pathological investigations have rendered in the practice of timber sales it is safe to say that they merely expressed in more precise and accurate terms and figures what experience had already made familiar to the practical forester. A new note was struck with a large series of divergent studies all of which had in common the endeavor to determine the bearing of detrimental factors, both of a biotic and physical character, on the production of wood in the forest. Whether wood already formed is broken down through decay or whether mistletoes, bark and foliage diseases, smelter fumes or other physical agencies exert a depressing influence on the normal production of wood, the economic end result is the same. Here lies the true field of forest pathological research which thereby reaches beyond the minute study of the individual factor into the realm of wider relationships.

Many examples could be adduced. The killing of young stuff by the devastating white pine blister rust is often of a spectacular character, but the relative damage is not uniform throughout. In former attempts at a valuation of the damage done by the rust the percentage of trees killed has been used as a basis. It has recently been shown that this method rests on a fallacy, for the very reason that it disregards

the effect on the probable productiveness of the stand concerned. Except in violent epidemics in which the stand is practically wiped out the killing is equivalent to a thinning which may be light enough to have a beneficial effect on crowded growth while more severe attacks reduce the density of the young stand far below the point conducive to adequate production. The heaviest damage results in stands of normal and subnormal stocking.

In so far as forest fires burn out deep scars in the lower part of the bole the loss accruing from this actual destruction of wood-mass comes well within the realm of pathology. The direct loss is relatively small. The indirect damage from decay traceable to wounding of the tree by fire, on the other hand, is immense. It makes up three-fourths and more of the total cull, varying in different species. This tremendous loss furnishes one of the strongest arguments for the necessity of preventing even lighter forest fires, since it has been shown that deep and large fire scars are generally the result of a number of successive fires none of which was sufficiently severe to consume the tree. Fire scars heal over but slowly and the longer they remain open the greater is the chance of their becoming infected. In the appraisal as well as in the marking of a given stand the prevalence of large fire wounds gives, therefore, a valuable clue to the relative soundness or unsoundness of the timber.

Of all the many pathologically active factors which affect the final yield of the forest, decay is without doubt the one giving most concern. The normally growing forest of given composition of species and ages could be expected to yield, on a given site, a definite volume of timber were it not for the fact that wood-destroying fungi take a certain toll and that for certain species this toll is excessive. The net production always remains below the apparent volume. Unless the probable loss can be predicted with some degree of accuracy the final yield at the end of the presumptive cutting period, the length of which is in itself a matter of speculation, may fall far short of expectations. The cull per cents for given species and areas already referred to could serve for the valuation of the probable loss if the standards employed remained constant. The cull per cents give the relation of cull to merchantable volume. Both cull and merchantable volume concepts are merely functions of the prevailing standards of utilization. They have undergone modifications in the past and there can be no doubt that the growing timber shortage will bring further profound changes. A different type of research which attempts to discount the change in

attitude of the future wood-user towards cull and merchantability has opened up new lines of thought.

CULL AND ULTIMATE YIELD

At an early stage it had become apparent that an intimate relation exists between the age of the stand and the occurrence and amount of decay. In youth, particularly before heartwood is formed, the trees are practically free from decay. But even after the age of infection is reached, decay does not immediately become a disquieting factor. Later a combination of slow growth and heavy wounding seems to favor the development of the wood-destroying fungi which reduce more and more wood-mass to decay. During this period the curves for stand volume and decay volume by age classes follow more or less the same direction until from a certain age on the decay volume curve swings upward rather rapidly. The age at which this change occurs has been called the "critical age" because it denotes that stage in the development of the young stand when the loss factor is likely to reach economic importance. Later in the life of the stand a further change is noticeable when even thrifty trees, particularly if heavily wounded, are liable to serious decay. This "age of decline," however, falls beyond the probable felling age in the coming forest, at least for the species so far studied. The critical age forms the most reliable basis for the determination of the pathological rotation by which is understood the rotation limited by pathological factors and beyond which the expected cull exceeds the admissible margin of loss. The critical age is not distinct in all species and may merge into the age of decline. Both consider the end product, and it is left to the judgment of the silviculturist which criterion affords the best guide to the limitation of the rotation.

The problem of the choice of felling age and rotation can be approached from a different angle. Instead of using as the criterion the final wood-mass available at the end of a given period the felling age may to greater advantage be fixed at the time when the rate of wood production is on the wane. Here also the exception of undue loss from decay may assume the rôle of a limiting factor. After decay begins to show in the young stand the periodic increment is in part offset by the increment of the decay. The curves of the two functions do not run parallel with each other. With increasing age the decay increment curve approaches the stand increment curve more and more until it finally crosses it with a strong upward swing while the stand increment curve descends. The meeting point of the curve occurs at widely different ages for different species. It lies in general far beyond the

probable felling age. The same problem, however, presents another aspect. In the choice of a prospective felling age and rotation the leading criterion is not so much the consideration of the ultimate performance of a given stand under given conditions if it were left to itself until it had reached the natural limit of its life, as the determination of the net wood volume to be expected at certain intermediate periods. No matter how fast and vigorously the stand grows, the increment can never overcome the handicap of the accumulated and still progressing decay volume. In the profit and loss account of a given age class the decay volume represents more than current deficit. It has the character of an irreducible and irremediable loss which is carried forward as a dead weight from one period to another. In addition this loss steadily increases until the time arrives when it equals and soon exceeds the corresponding stand increment. Perhaps the felling age and length of rotation should be limited to an age class when the stand increment ceases to compensate for the greater part of the accumulated decay volume.

The studies on which the foregoing considerations are based involve an infinity of detailed work, and owing to the dearth of adequate funds and trained investigators only few species have been covered. Practically all of these have their home in the western forests. Only one forest association is fairly well known, that of the pine forests of the Sierra Nevada in California. In the northwest intensive studies on Douglas fir are nearing their completion, and certain species of Idaho and Montana have been investigated. The only other species covered is quaking aspen in Utah, and the results have become an integral part of a working plan for the management of aspen for its possible utilization for pulpwood. The rest of the Rocky Mountain region, the Southwest, the Lake States, the Southern forests, the Appalachians and the entire east have not yet been touched. There can be no doubt that the newly awakened interest in reforestation in the east will bring with it the demand for reliable information which may aid in the formulation of plans for rational management.

An immense field of research has been barely touched, and still it stands to reason that, if the aim of constructive forestry is the sustained production of wood in paying quantities, the cull factor must be reduced far below present indications. The goal can be reached only by offering the young forest a fair start under suppression of those agencies which favor cull and by adjusting the management of the forest to prevailing conditions by the adoption of pathologically limited felling ages and rotations.

Timber production stands in close relation to the problem of timber depletion, which is unduly promoted by excessive waste in the manufacture and use of wood products. A large part of the preventable waste is due to the action of fungi and the lack of precautions taken against their ravages. A special branch of the Office of Forest Pathology, connected with Forest Products Laboratory at Madison, Wisconsin, deals with the many problems involved.

OUTLOOK

The net results in actual achievements of the last twenty-five years seem small indeed when compared with the huge field still lying fallow. What the next quarter of a century will bring is hard to predict. Two general subjects seem to stand out from the rest, a genuine pathological survey covering the entire country and the extension of cull studies to all important species and associations.

To be of practical value, the survey must be based on a clearer understanding of the relative importance of each injurious factor and of the specific rôle each plays within its range. Such a rating can be arrived at only through a long series of detailed investigations.

The extension of cull studies to all the principal commercial species of the United States constitutes so ambitious a plan that its completion can not be looked forward to for many years. Above all it requires man power. The number of trained investigators in the United States qualified to undertake pathological research without losing sight of the objectives of constructive forestry is exceedingly small. Pathology has always been a neglected field in forestry schools. Up to a very recent time the discipline has either not been taught at all, or it has been confined to the mycology of the forest. Even today the schools going beyond an elementary presentation of the subject are very rare. Not until the young forester in the exercise of his profession is confronted with the perplexing problems of cull and loss does he begin to realize that in forest production, as in all business, there are two sides to the ledger. Of the present apparent capital of standing saw timber in the United States over 300 billion board feet at a low estimate, or more than 14 per cent, must be discounted as cull due to decay. What the loss may amount to in the young forests to which the country has pinned its hopes for a replenishment of the waning timber supply can only be guessed at. There is no doubt that the loss will cut heavily into the expected gain. It is time that serious thought be devoted to the negative side of wood production not only by pathologists but by the practical forester.

FOREST PROTECTION—DISEASES

Comment on Meinecke's Paper

By J. S. Boyce

Forest Pathologist, Portland, Ore.

Probably the most important point touched upon by my distinguished teacher on whose paper I have been asked to briefly comment, is the necessity for the exact evaluation of damage to the forest caused by biological and physical agencies. Too often it is accepted that mere injury or killing in themselves call for measures of prevention or control before it is known whether the actual damage, based on the present and future value, purpose and productiveness of the stand, warrants such measures. The elimination of a single species from a mixed stand valuable only for watershed protection would be of little moment if replacement by another species was rapid and complete. In the killing of reproduction by any disease actual damage occurs only if the losses are so heavy that the mature stand is not fully stocked or is lowered in quality. Application of this idea to injury by white pine blister rust may show that the complete eradication of all species of currants and gooseberries from white pine stands as now practiced in local control can be modified.

Of the need for a pathological survey covering the entire country there is no question. But, at least in part, such a survey must be carried farther. It will not suffice to study only those fungus parasites indigenous to North America that are injurious to forests, but in so far as possible those potentially dangerous occurring throughout the world, particularly in the temperate zone, must be known. It is only with this knowledge that proper quarantines can be promulgated to prevent the introduction of unwelcome guests and that adequate control measures can be immediately undertaken, once a foreign parasite is introduced. Chestnut blight and white pine blister rust are mute evidence of the necessity for a knowledge of tree diseases cosmopolitan in scope. In keeping with this idea, that potential danger, Douglas fir canker, now so common in Great Britain is being studied there by pathologists from this country.

The loss in forest products, briefly touched upon, is tremendous. Furthermore, the means promising the greatest return in the shortest time by which forest pathology can aid in checking timber depletion lies in reducing this loss. It is estimated that of the total amount of timber removed annually from the forests of the United States, 16.5 per cent is yearly destroyed by decay. At least half of this can be obviated by the application of known preventive measures and future investigations should make it possible to reduce this loss still more.

ADJUSTMENT OF STUMPAGE PRICES IN LONG TERM SALES

By Theodore S. Woolsey, Jr.

Consulting Forester

The Forest Service has taken the lead in drawing up contracts that provide for an automatic adjustment of stumpage price, based on an increase or decrease in the value of the manufactured product. This form of readjustment clause did not work well during the war period, because, owing to rapid price changes, either the buyer or the seller lost money. Where the prices of lumber rapidly increased during the readjustment period the government received less than it should have and where, as in 1920-1921, there was a sudden deflation, the purchaser's vanishing market and much reduced prices caused him severe losses. As a result of this experience the Forest Service policy is to have a complete reappraisal made at stated intervals. The current contract clause is about as follows:

Sec. 2. (a) We do hereby, in consideration of the sale of this timber to us, promise to pay to the.....Branch, Federal Reserve Bank, at....., ..., (United States depository), or such other depository or officer as shall hereafter be designated, to be placed to the credit of the United States, for the timber as follows:

For all timber scaled prior to June 1, 1930, at the following rates:

$————per M. feet B. M. for western yellow pine.

$————per M. feet B. M. for Douglas fir, western larch, white fir and lodgepole pine.

For all timber scaled on or after June 1, 1930, and prior to June 1, 1933, at such rates as shall be designated by the Forester within thirty days preceding June 1, 1930.

For all timber scaled on or after June 1, 1933, and prior to June 1, 1935, at such rates as shall be designated by the Forester within thirty days preceding June 1, 1933.

For all timber scaled on or after June 1, 1936, and prior to June 1, 1939, at such rates as shall be designated by the Forester within thirty days preceding June 1, 1936.

And for all timber scaled on or after June 1, 1939, at such rates as shall be designated by the Forester within thirty days preceding that date.

(b) The Forester shall reappraise and within thirty days before each of the foregoing dates designate the value of each species in consideration of current operating conditions and markets in the Eastern————region, including the operation of the purchaser, such reappraisals to include the timber on the entire tract, and to be based upon an equitable margin for profit and risk to the purchaser under the operation conditions prevailing throughout the region.

(c) If any material cut under this agreement and merchantable under its terms is manufactured or sold by the purchaser in other forms than saw-

logs the Forester may, upon the next reappraisal date, establish a special stumpage rate for each class of material so manufactured or sold during the succeeding period, which rate, in accordance with the ratio per thousand board feet currently used by the Forest Service, shall be not less than the initial stumpage price fixed herein and shall allow the purchaser an equitable margin for profit and risk under current selling prices and costs of production in the region defined above.

(d) It is further agreed that the Secretary of Agriculture will, upon written application from the purchaser showing good and sufficient reasons therefore and specifically the existence of a serious emergency arising from changes in market conditions since the last reappraisal, at his option, when action of either character is necessary to relieve the purchaser from hardship, either—

(1) Redetermine and establish the stumpage rates and designate a date when the rates, as redetermined, shall be effective, which date shall be within six months of the date of application; or

(2) Grant an extension of time within which the respective amounts of timber specified in Section 4 shall be removed, not to exceed the total period allowed for cutting all the timber.

Any stumpage rates redetermined upon application to the Secretary shall be determined in accordance with the methods and under the terms above set forth, and shall apply only during the remainder of the three-year period then current when the rates shall be regularly designated after reappraisal.

(e) In no event, however, shall the stumpage rates for products from material whose utilization is required by this agreement as established upon any date above named, or upon application from the purchaser, be less than those specified herein to be paid for timber scaled prior to June 1, 1930.

(f) It is further agreed that at the date of any reappraisal of stumpage prices, the Forester may require such modifications in the sections numbered 6, 13, 18, 19, 26, 28, 29, 30, 31, 32, 33, 34, 39, and 40, in this agreement as are necessary in his judgment to protect the interests of the United States. Such modifications shall be limited to requirements contained in the then current timber sale contracts in Oregon and Washington and shall be practicable under the existing equipment and organization of the purchaser. Any additional operating costs entailed by such modifications as ascertained by the Forester, shall be taken into consideration as a factor in reappraisals.

In British India continuous forest management under one administrative head is recognized as essential to efficient forest practice. The current method there is to enter into long term leases and to give the owner of the forest 90 per cent of the "surplus revenue." As example of this form of contract is the indenture made May 21, 1920, between the Court of Wards, representing the forest owner, and the Secretary of State for India:

1. The lease shall extend to the said three forest blocks only which are delineated in the map attached to these presents and their boundaries more particularly set forth in the forest schedule hereunder given. The rest of the forest belonging to the estate has been excluded and left to the management of the lessor entirely.

2. The lease shall continue in force for a term of fifty years from the date of these presents;

Provided that in the event of the Court of Wards relinquishing its management of the said estate, the Zamindar may terminate this lease after giving to the lessee six months' notice in writing of his intention to do so.

3. The lessee shall be entitled to collect in the said three forest blocks all revenue from all sources specified in paragraph 91 of the Working Plan Report prepared by the Forest Department of the Central Provinces on behalf of the lessee, which paragraph is reproduced in the second schedule hereunder written.

4. (a) The rent payable to the lessor by the lessee every year during the term of this lease shall be 90% of the surplus revenue collected by the lessee over the expenditure incurred by the lessee in the management of the said three forest blocks;

(b) The revenue shall consist of all collections from all sources made by the lessee in conformity with these presents with the exception of collections from grazing which, less any commission paid to license vendors for the issue of the grazing licenses shall be paid in full by the lessee to the lessor in addition to rent.

(c) The expenditure shall consist of all expenditure incurred in the management of the said three forest blocks including—

(1) The cost of the establishment specially maintained for the purpose.

(2) A share of the establishment charges of the forest ranges in which the said three forest blocks are situate based on the proportion between the area of the said three forest blocks and the area of the ranges in which they are included;

(3) A share hereby fixed at one-sixth of the pay of the Divisional Forest Officer, Chanda and of the cost of his office establishment;

Provided that the amount of such total expenditure shall in no year exceed Rs 12,000/—.

5. A balance sheet showing the receipts and expenditure in connection with the management of the said three forest blocks shall annually be supplied by the lessee to the lessor.

6. The lessor agrees that on request made by the lessee he will make an application under section 38 of the India Forest Act, 1878 (VII of 1878) to have such provisions of the said Act supplied to the said three forest blocks as the lessee may specify.

Neither the Forest Service reappraisal method, nor the current practice in India would be possible between private corporations.

Very long contracts in most business undertakings are, if possible, generally avoided by able executives. There are many uncertainties. Besides, too many changes in conditions may occur during the contract period. But with owners of timber land bent on the permanent production of timber, there are strong arguments why long term contracts are very vital to the success of conservative forest management. The most usual instance of this is where the amount cut is restricted to what the forest will produce. Consequently, the annual cut is comparatively small and must be extended over a considerable number of years in order to justify the investment necessary to properly log and manufac-

ture the amount of timber annually salable. The Forest Service, wishing to develop large timber tracts back from the centers of transportation, has been forced to make sales for 20 years. Enough timber had to be sold to justify the construction of expensive improvements such as logging railroads, flumes, dams and sawmills. Among private timber land owners, it has usually been the practice to sell the timber outright and allow the purchaser to remove it as rapidly as he could. The objective was not to cut what the land would periodically produce, but to turn timber capital into money in a single quick operation. There are instances of the sale of stumpage extending over a period of years. There have been cases where, after agreeing on the initial stumpage price, future prices were based on the cost of carrying the timber. A timber land owner sold valuable stumpage with the understanding that the stumpage would be increased six per cent per year—roughly equivalent to the cost of carrying the timber. Where two private corporations are dealing in stumpage, it is doubtful if a readjustment of prices based on a reappraisal by the vendor would be at all acceptable to the purchaser. Something more definite is needed. In one instance it was suggested to a purchaser, who wanted to buy for a term of 10 years, that the vendor would be satisfied with an annual increase in the stumpage price based on one-half the carrying charges or roughly three per cent per year. This, the purchaser refused to accept. As a result of long negotiations, a satisfactory readjustment clause in an Eastern timber sale was finally agreed upon as follows:

> And at the end of each five-year period thereafter,* throughout the legal existence of this contract, there shall be a readjustment in stumpage prices, as follows provided that in no event shall the readjusted price be less than the prices established for the period ending June 30, 1930.
>
> SPRUCE
>
> a. The "base" price of spruce lumber on which changes in the price of spruce stumpage are to be calculated shall be $44 per thousand board feet.
>
> b. The average "base" price of rail shipments of New England Spruce frames *eight* (8) *inches and under,* eight (8) to twenty (20) feet in length as quoted in the Commercial Bulletin of Boston, Mass., shall be computed at the end of each five-year period at which a readjustment in price is to be considered, by taking the price of this class of lumber for each of the 52 weeks of the five-year period as quoted in said Commercial Bulletin and determining the average price for the 260 weeks period which has elapsed.

*In this case I wish that the purchaser had agreed to an *annual* or *biennial* instead of only a five-year readjustment. The oftener the readjustment, the fairer is the contract all around. T. S. W., Jr.

c. The price of spruce stumpage as quoted in this contract shall be increased at the rate of 29 cents for each one (1) dollar increase in average value over the base price as agreed upon in "a," said increase in value being determined in the manner indicated under "b."

The prices for white pine, hemlock, fir and hardwoods were adjusted in a similar manner, but from different base prices and with different percentages of the averages over the established base. Furthermore, possible disagreements were foreseen and a special clause was inserted which provided for compulsory arbitration without infringing upon the rights of either party to bring suit.

The timber was about two-fifths exceedingly valuable spruce (25 per cent suitable for clapboards and piano stock) and three-fifths mature and overmature hardwoods. After an appraisal and understanding as to present values, it was agreed (in accordance with the clause just quoted) that the initial stumpage price should never be decreased. In support of this policy it was argued that, as a general rule, stumpage has been becoming gradually more expensive. It does not rise or drop with the lumber market. If hard times come on, a few stumpage owners may have to sell for less than current values; but usually the timber owner simply carries his stumpage until the lumber slump is over when he sells at its real value. Professor Bryant of the Yale School of Forestry was able to prove this by actual commercial figures. And if this is accepted as sound, then the Forest Service system of periodic reappraisal is theoretically unsound but very practical where the purchaser can absolutely trust the vendor to make an accurate and just reappraisal. Periodic reappraisal simply means that the long term contract is divided into a series of short term sale contracts. As a matter of fact it seems fairer not to base future prices on conditions on one date (the date of reappraisal) but upon the business conditions that have existed since the last price change.

In the contract under discussion the purchaser had a slight advantage in that he could stop cutting for a year and yet, during such a year of presumably *low prices* the market figures would be averaged to make up the 260 weeks' mean figure. This would reduce the price for the second five-year period, to be sure, but, as a matter of fact, it would be difficult for any operator to stop all operations. Few lumbermen could afford to let their men go on the chance of picking up woods and mill crews when the market improved.

A number of other problems are involved. In the first place, to make this form of contract workable, it is vital to establish a base price from which increased stumpage can be computed. It is also essential that prices for lumber grades upon which the base price is founded, should be published in a reliable journal at frequent intervals. Under present conditions, for example, the Commercial Bulletin of Boston, Mass., is reputed to quote such reliable figures for spruce frames eight inches and under, 8 to 20 feet in length. But the question now arises—will these quotations be continued indefinitely? Will the grading rules remain approximately the same and will the product itself continue to be of enough commercial importance to justify quotations at all, or will a similar product imported from the Pacific Coast replace spruce frames? These were added arguments for an arbitration clause. Another important consideration: What per cent of each dollar increase over the base price should be taken by the stumpage owner and what per cent should accrue to the benefit of the purchaser, who assumes all the manufacturing risks? In the case cited above, the per cent accepted by the two parties was the present ratio between the stumpage price and the base price. This was well enough for spruce, but in the case of hardwoods it was necessary to take the No. 1 common grade on the Boston market, which does not correspond to the average mill run value. With hardwoods then, the per cent had to be arrived at by mutual consent. In the contract in question, the average mill run value at the time negotiations were conducted was probably close to $38.00, yet the base price adopted for birch and maple No. 1 common was about $64.00. It was also vital to arrange for the publication of prices for a grade which was of commercial importance. Reliable local mill run values for hardwoods were not available, nor was it possible to have special tallies made periodically to determine such values. Obviously, it would have been unfair to take firsts and seconds (clear) as the base price. The desire was to get the spread of prices between the present base price adopted in the contract and the average run of prices for the following 260 weeks or five-year period. If the higher grades like firsts and seconds (clear) had been adopted, the spread would have been too great; therefore, it seemed acceptable and practicable to simply agree on the No. 1 common grade—in wide use and quoted in the Boston Commercial Bulletin after October, 1924. The justification for all these details was to have the adjustment a question of arithmetic and not of judgment. There could be no dispute about the averages of published figures and

their application to future stumpage prices where the method of application was fully set down in black and white.

Possible objections to this method of readjustment may be raised because the percentage increase over the base price is fixed throughout the life of the contract. Twenty or thirty years from now, will not forest owners receive a higher proportion of the final value of the manufactured product? For example, let us assume that today our base price for spruce of $44.00 per 1,000 is also the average mill run price and that our stumpage is $13.00. In other words, we get 29 per cent of the final market price. Let us also assume that 20 years from now the corresponding base price and average mill run price will be $80.00 per 1,000 and the stumpage $30.00. Then the timber owner would receive 37 per cent of the value of the final product as grouped with 29 per cent to begin with. In the contract cited, our proportion of the final price remains constant throughout the life of the contract, whereas it probably should be an arithmetical progression. I have never seen this factor discussed in this country, but I know in France, where growing timber has been a business for more than a century, that today the stumpage owner receives a larger per cent of the final market price of the manufactured product than do owners in the United States. If the same movement of prices occurs in North America, stumpage owners should profit.

It might be considered even better to first appraise a "going price" for a given period and then modify it *for the elapsed period* if business conditions warranted. But probably the average purchaser would object to paying *extra stumpage* for timber already cut and sold. Suppose a buyer paid $10.00 per 1,000 feet for 10 million feet, or $100,000.00 for his raw product. If the readjustment base were $30.00, and the average sales value of the base price grade $40.00 during the readjustment period, then if 33⅓ per cent of the increase accrued to the seller the buyer would be called upon to pay $33,333.00 besides the $100,000.00 already paid and *after the transaction was ordinarly closed*. Few would agree.

Undoubtedly flaws will develop in any readjustment clause no matter how carefully it may be studied. Some unforeseen price movement may arise to make necessary a "give and take" settlement between the vendor and purchaser. But this problem remains: given a forest devoted to permanent timber production, under ordinary circumstances

the stand must be sold gradually. The cut can not exceed the producing capacity of the land, plus a percentage of the stand above the timber capital normally required for the soil quality and type of forest in question. Usually small detached sales will be found less satisfactory than a continuous operation by a well-known and reliable company. The evil of a long term contract will apparently often be necessary unless the owner is willing to scrap his timber capital very rapidly or make small sales to inefficient local operators. It is an important problem that foresters must meet. As years go on undoubtedly it will be solved in a satisfactory manner; in the meantime, forest owners must pioneer and trust partly to the good faith of their purchasers.

A KEY TO THE IDENTIFICATION OF SOME CONIFEROUS SEEDLINGS

By Carlos G. Bates,

Silviculturist, Fremont Forest Experiment Station, U. S. Forest Service

In comparative experimental studies in the greenhouse, and in making observations on reproduction in the field, the forester is constantly having to distinguish the seedlings of different species before they have developed the foliage, buds, twigs, etc., by which older trees are recognized. One quickly learns the distinguishing marks of the species with which he is constantly dealing, yet in certain instances these distinctions are exceedingly difficult to describe to, for example, a student assistant who must be assigned a task of counting.

The present effort to place on record, for the benefit of others, the marks by which we have learned to distinguish a limited number of species in our work at the Fremont Forest Experiment Station, has, without premeditation on our part, brought out two relationships, apart from morphological distinctions. At the Experiment Station we have dealt in considerable measure with the three pines of the Lake States, as well as the more important Rocky Mountain species. It is hoped we may be excused for considering these two groups together, because of the undoubted taxonomic relationships between jack pine and lodgepole pine, between Norway pine and western yellow pine and between white pine, limber pine and bristlecone pine, which are brought out by considering these embryonic plants (seedlings).

The other relationship brought out is an ecological one, though we are not as yet prepared to elucidate its true significance. The first line of distinction in the key given below is on the matter of red coloring, or lack of it, in the stems of seedlings. Some recent work by Harvey[1] has shown that red coloring in plants is protective coloring, the fact that red rays are reflected in itself indicating that the most heating part of the solar spectrum is not being absorbed. Our ecological studies, as well as recent work by Toumey and Neethling,[2] and others, have indicated that superheating of stems at the surface of the soil may frequently cause injury, if not death of the seedlings. It is, therefore, of interest to note that western yellow pine and pinon, the species which grow at low elevations and on the warmest sites in the Rockies, have this protective coloration when they first appear above ground. Norway

[1]Harvey, R. B. Red as a Protective Color in Plants. Annual Rep. Minn. State Hort. Soc., 1923, p. 279.

[2]Toumey, J. W. and Neethling, E. J. Isolation a factor in the Natural Regeneration of Certain Conifers. Yale Univ. Press, New Haven, 1924.

pine is almost identical with western yellow pine in this, as in other embryonic characters. Douglas fir is well protected on the stems, and so far as we have observed is not readily injured at the ground line. But Douglas fir cotyledons are comparatively broad and flat, which would give them greater surface to absorb radiation, and are readily injured by excessive radiation. How to explain this, and how to explain the usual lack of pigmentation in the seedlings of jack and lodgepole pines, both of which thrive on completely denuded soils and under intense radiation, are difficulties. Regarding the Douglas fir, however, its adaptation of stem without adaptation of leaves suggests an origin in a warm, low-altitude climate where soil temperatures may be high, and where yet the solar radiation is not so intense as in the Rocky Mountain region. Perhaps the Pacific Coast conditions would answer this description. At any rate we know that Douglas fir is a comparatively poor tree in the Rocky Mountains, and appears to have great difficulty in maintaining its hold, except with a good deal of protection in early life.

In preparing this key, characteristics which appear up to the end of the first year of growth have generally been indicated.

I. Young stems green.

A. Cotyledons 2, flat and blunt.

Juniperus

B. Cotyledons 3-6, usually 4, and usually of unequal size, perfectly straight and spreading at angles about 45 degrees. Small and frail.

1. Primary needles usually short, and sometimes broadly awl-shaped in strong seedlings, forming an oval head. Cotyledons dry by end of year. Color pale green to purplish green.

Pinus contorta

2. Primary needles longer and usually linear, secondary needles sometimes appearing before end of year, cotyledons dry, color deep green. Except for seedlings of especially strong axillary development, lower needles longer than others giving a concave top effect.

Pinus divaricata

C. Cotyledons 4-7, usually 6.

1. Tiny frail seedlings, pale green throughout first year, the cotyledons almost invariably drawn inward at the tops and more or less twisted, persistent but nearly dead by end of year. Primary needles appearing early but developing only slightly.

Picea engelmanni

D. Cotyledons 8-10.

1. Cotyledons usually 8. Strong seedlings, usually more than an inch in height when unfolded, a dull bluish-green, the cotyledons spreading and turning upward in bowl shape, fleshy, green and persistent at end of year. Primary needles usually appearing early and forming a strong cluster by end of year.

Pinus aristata

2. Cotyledons usually 10, more than an inch long. Stronger and larger seedlings than the last, the cotyledons more widely spreading, sometimes dry by end of year, but more conspicuous than in *aristata* because of slower development of primary needles.

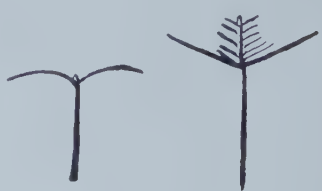
Pinus flexilis

E. Cotyledons 10-12, very slender and wide-spreading, the color yellowish green. Primary needles slow in developing.

Pinus strobus

II. Young stems more or less red.

A. Stems deep purple throughout first year, only occasionally green. Cotyledons usually 6, wide and flat, wide-spreading and often curved downward but never upward. Primary needles developing spicately if at all during first year.



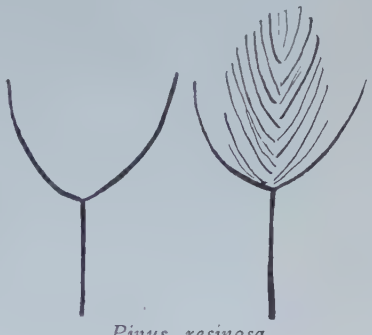
Pseudotsuga taxifolia

B. Stems red or pink only at base when seedlings first appear, color disappearing as stems become more woody. Cotyledons 5-8, commonly 6.

1. Cotyledons usually an inch or more in length, closing together at tips long after seed-coat is dropped, invariably dry by end of year, with primary needles and occasionally secondaries developing early and in a narrow oval head.

Pinus ponderosa

2. Cotyledons usually less than an inch, spreading as in *ponderosa* but not drawn in at tips, and usually green at end of year. Similar to *aristata* after development of primaries, but cotyledons not so fleshy nor so conspicuous.



Pinus resinosa

C. Stems usually only brownish-red when seedlings first appear, quickly becoming woody. Seed-coats very persistent* and primary needles appearing at once. Cotyledons 8-10, large and spreading, in bowl shape, withering early, while blue glaucous foliage develops rapidly in spicate form.

Pinus edulis

*Before the cotyledons fully unfold to the sum, the tap root may penetrate 6-8 inches into the ground, showing a clear adaptation to conditions of deficient moisture.

FOREST MENSURATION TO-DAY

By Donald Bruce

Silviculturist, Branch of Research, U. S. Forest Service

American forestry has, until recently, failed most notably in two respects. First, instead of being a profession it has been a crusade. Second, it has not been a true science. It is impossible to analyze the progress of mensuration during the past quarter century without vividly appreciating the latter of these two failures.

In its infancy, forestry in this country laid great stress on mensuration. The earliest work of the Bureau of Forestry concentrated the highest ability of the new-born profession on growth studies and on working plans based on mensurational data. That the work done was crude and inadequate in many cases is no reflection on the ability of these early foresters. Mistakes in this formative period were inevitable. Later, when professional interest had become diverted by the problems of administration on the National Forests, it is equally easy to understand, but impossible not to regret, the almost naive general acceptance of the earlier work. There followed a period of mensurational apathy during which there was little demand for accurate mensurational information in which both conventional technique and published results were languidly accepted as quite good enough for all immediate needs. Today we are feeling a revulsion from this complacency and every concept of the past is being keenly challenged. The weapon with which the challengers are armed is the method of the modern science of statistics.

The results of the past decades are imposingly voluminous. Uncounted thousands of data sheets are dustily stored in the vaults of the U. S. Forest Service and in the files of State Foresters and of Forest Schools. Hundreds of volume tables and dozens of yield tables have been published or circulated in manuscript form. In spite of this large mass of material one is all too frequently startled to discover that in the midst of the apparent abundance, the one table needed to solve an urgent problem of the moment does not exist. A forester recently sought a volume table for eastern white pine in terms of the International Rule. Such a table apparently does not exist in spite of the high importance of this species and the widespread acceptance of this log rule for scientific work. There are over 80 volume tables for western yellow pine extant (of which at least a dozen are still being distributed for

use), based on some 15,000 tree measurements. There are radical differences between the values in different tables, but there is no adequate basis for determining which should be used in a specific piece of work. And there is reason to suspect that some 3 to 5 new tables would do the work of all those now in use with a considerable increase in accuracy.

It is the inaccuracy of the current tables that is most disturbing and this inaccuracy is not only in detail but is commonly the result of erroneous methods. I recently had occasion to examine the process which has been followed in preparing a yield table for an important conifer. I found that the same sample plot often played consecutively the role of Site 1, Site 2 and Site 3, according to the demands of the moment. This resulted from an independent zoning of plotted points for each new variable studied. As a consequence, any badly understocked plot was inevitably Site 1 when average d. b. h. was being investigated, but was with equal certainty Site 3 when volume per acre was at issue. Tables thus prepared will rarely bear critical analysis, but apparently they were received by the profession with something between confidence and indifference.

Among the important failings of our mensuration to date has been a reliance on graceful curves. Apparently the aesthetic sense of the forester has been more highly developed than his scientific discrimination. Unfortunately, it is as easy, perhaps easier, to draw a beautiful curve through a galaxy of plotted points than through an array that definitely suggests some underlying law. The results may be published with a semblance of overwhelming finality merely by omitting from the graphs the basic points. This procedure, which has deprived the reader of the opportunity to criticize or judge the reliability of the conclusions reached, has been particularly unfortunate because the investigator himself has rarely checked his own work by proper methods. He has, moreover, obscured even from his own eyes in many instances the wide dispersion of his data by the use of "average points." Now average points, resulting from combining a number of observations before plotting, may be a decided help in locating a curve, but they introduce serious dangers. Like any averages, they are of varying reliability and this reliability depends on two factors, the number of observations on which they are based and the dispersion of these observations. The forester has usually retained the former by entering it as a "weight" alongside the plotted point, but he has allowed the latter to drop into oblivion.

In his love of the beautiful he has also had a tendency to become

devoted to harmonized curves. It is a difficult enough task to locate a single curve through scattered points properly; it is far harder to locate a family of curves involving three variables without an enormous number of data. Yet foresters have been fond of extolling the advantages of taper curves in which a far more complex problem in harmonization is involved. There has come to my attention but one instance where taper tables thus prepared have been adequately checked and the author of these at once decided not to publish them.

It is a tedious and an ungrateful task to prolong this criticism of our earlier days, but there is one more type of error that demands specific mention. This is the interchanging of the dependent and independent variables. It is amazing how frequent this error has been. It seems so obvious that the diameter-height relation must be a simple inversion of the height-diameter relation that the mere fact of the fallacy of this statement seems trivial. Few of us, moreover, have troubled ourselves to investigate quantitatively the importance of this error or have known through statistical technique how it may be measured by correlation coefficients, yet it is not uncommon to introduce errors of over 100 per cent in this way.

There are two, and so far as I know only two, scientific methods. The first is that of the laboratory. It consists in holding constant all the variables but one in a problem, and then watching and measuring the effect of changes in that one. It is a method obviously impossible of general application to forest mensuration. The second is that of the modern science of statistics which consists in a rigorous mathematical analysis of the effects of a free interplay between the variables. Based on a foundation of rather abstruse mathematics and little stressed by the German forestry from which ours has been too exclusively derived, it has until very recently been not only out of the reach of American foresters but beyond their ken. Obviously it is ideally suited to our problems but it is not taught in our Forest Schools, it finds small place in our literature, and has so far been little used in our research.

Today there are perhaps a dozen foresters in America (and one must include the Canadians to muster even this number), who have any real grasp of the statistical method and most of these feel keenly their inexperience. Their accomplishments have not been great but their efforts have already aroused a mild interest among a larger number of foresters. The attitude of the profession as a whole, however, appears to be still one of apathy and languid complacency. If this continues

the time is not far distant when the bulk of the profession will be unable to interpret intelligently the results which our forest experiment stations produce. They will doubtless blame this situation on the abstruseness of the research men rather than on their own lethargy.

A paper such as this can do no more than mention a few specific examples of the type of service the new method can deliver. Turpentine investigations in Florida have been carried on, using in each test a series of 50 trees. Variations between individual trees in each series is so great that the value of averages of such small numbers is now considered dubious. It is obvious that further experiments should be made on a larger scale. But on a how much larger scale? A statistical analysis of the data collected involving a determination of the standard deviations of the group averages should give a satisfactory estimate of the number needed.

Nursery experiments often result in rather small differences in the germinating per cent. Such experiments are usually on a small scale. Are these differences significant or are they an accidental result of the small number of data? A comparison of the differences obtained with the computed probable error of this difference will give an estimate of the odds in favor of or against either hypothesis.

Yield tables have customarily furnished information for various sites and ages, as to volume, basal area and number of trees per acre and the dimensions of the average tree. They have usually failed to answer questions involving the number of trees above or below certain diameter limits. In other words, they have failed to supply a complete set of stand tables. Such a set, prepared in the conventional way, would be both too voluminous and too inaccurate to be of value. Recent investigations indicate that the application of the Gauss-Laplace law to diameter distributions leads the way to the preparation of a single chart bearing two curves by means of which any question which has in the past required a stand table for its solution can be readily and accurately answered.

These are but three illustrations selected from a field of limitless scope. Two of them have intentionally been chosen from fields other than mensuration, for, while the new technique is of the greatest service here, it is of equal applicability to almost any branch of forestry which involves quantitative observations.

If I have painted a somewhat gloomy picture of the past accomplishments of mensuration it is not because of any pessimism, but to

emphasize the scope and importance of what remains to be done. The task ahead involves first of all the adoption of this new technique by the profession. The schools must teach it, research men must become more expert in its use, and the profession as a whole must become sufficiently familiar with the fundamental conceptions involved to understand the work of the investigator and to interpret and apply his results.

The schools should take the lead either through a progressive modification of existing courses in mensuration, through the addition of a new course in advanced mensuration specializing in statistical technique, or through the incorporation into the curriculum of general courses in statistics which may be already available as offered by Departments of Economics. This will both give future research men the foundation they require as the basis for specialized endeavor, and acquaint the new professional generations with the general concepts of the method. The rest will follow more or less automatically, for as research men progressively apply more and more of the new technique, the forester who is alert to keep abreast of current progress will almost unconsciously absorb what he needs. When this foundation is laid, we will be in a position to—start all over again on the fundamental problem of mensuration, i. e., to supply the profession with the essential basic tables of volume, growth and yield for our important species. This does not mean that all the past work must be abandoned but a critical review should be undertaken to determine what is sound and what is faulty. Much can doubtless be revised; much can be laid aside as no longer needed; some will have to be done over from beginning to end.

FOREST MENSURATION TO-DAY

Comments on Bruce's Paper

By C. Edward Behre

Northeastern Forest Experiment Station, U. S. Forest Service

Mr. Bruce has given a very sharp, but not too complimentary, picture of the situation in the field of Forest Mensuration today. He has laid all the emphasis on one phase of the situation, however, and in commenting on his paper I should like to point out other aspects which seem to me worthy of consideration in surveying the past and laying plans for the future.

As in any other field of scientific investigation a balance must be struck between superficial or "empirical" work, designed to fill the needs of the moment, and fundamental research leading to results of permanent value. Much of the work of the past will not bear the critical analysis upon which Bruce insists, because it is of superficial or empirical character, justified by the needs of the moment. If the work of the future is to be of more permanent value than that of the past it will not only have to follow scientific methods but must place more emphasis on fundamentals. Progress in solving some of our most urgent problems will be at a standstill until the fundamentals are worked out. For instance take the question of yield tables which Bruce has mentioned in his paper. The author of the yield table in which the plots were zoned independently for the study of each factor, thus hopelessly mixing the sites together, probably did so with a full understanding of the fallacy of the procedure. He probably was confronted with the necessity of producing, with relatively limited time and money, results giving some sort of an estimate of the yields to be expected. A study of all available information on the subject showed him that an entirely satisfactory method of classifying forest sites had not yet been discovered. Furthermore, when using height growth, the most commonly accepted index, for this purpose, he probably found the dispersion of the average diameters in Site 2, for example, just as great as the dispersion of the average diameters in the entire mass of material. Under such conditions I would put just as much faith in figures based on a zoning of all the plots as in a set in which a separation of sites of doubtful accuracy had been adhered to throughout. In my opinion a satisfactory solution of this problem will not be possible until the fundamentals of

the relations of such factors as density, height growth, competing vegetation, origin, etc., to site quality have been studied more intensively.

Another point brought forcibly to our attention in the light of scientific method is the importance of properly planned and coordinated field work. Too much of the field work upon which our volume and yield tables have been based in the past has been carried out without sufficiently coordinating it with the ultimate needs of the project or without tying it inadequately to physiological or ecological factors which might influence the result.

From the "imposingly voluminous" accumulation of records to which Bruce refers other lessons than the inadequacy of the results can be drawn. For one thing I believe entirely too much emphasis, in point of time, has been placed on the field work in the past. As soon as the weather permitted in the spring mensuration crews were thrown into the field and held there until winter forced them in. Administrative instructions stressed the importance of making fullest use of the field season, and in some cases even set limits to the proportion of time to be spent in the office. All available money was put into temporary assistance during the field season and great masses of material were accumulated through which it was hoped the regular force might wade in the winter season with very little, if any, help. There seemed to be a fear that work would run out and men find themselves idle before the next field season opened up. As a result of this policy very little, if any, of the field data were adequately digested before being relegated to the "closed files" and no time was available to systematically check the tables produced or inquire into doubtful points of technique. In my opinion a complete reversal of this policy is necessary if progress is to be made in the future.

In criticizing the past for failure to thoroughly digest the data collected and to systematically check results, we must not lose sight of the fact that until quite recently all the compilation had to be done mentally and by hand. Tasks which present no particular obstacles with the aid of the mechanical devices which are now available would appear almost insurmountable if tackled by hand. In fact, I venture to say that the work involved in the application of the statistical methods which Bruce stresses so strongly, in the majority of cases could hardly be justified by the results, if we had to depend entirely on hand work and mental computation. The development and general use of adding, calculating, and, more recently, of mechanical sorting and tabulating machines have cleared the way for more thorough-going analysis of field data and sys-

tematic checking of results by making feasible the application of statistical methods.

Without minimizing the importance of statistical methods, I wish to point out that progress has been made and can be made by other means. I have in mind particularly the field of graphic analysis which in many cases will serve where statistical method is of no avail. For illustration, the work of Baker, showing up specifically the systematic error in the old technique of taper table construction, involved simply a painstaking graphical analysis, and I do not see how the result could have been achieved through any of the devices of statistical method. Again, in studies of stem form, satisfactory comparison of the relative tapers of different species is made possible by certain devices of graphical analysis which could not be brought out by any of the usual statistical constants.

Profiting by the experience of the past, I believe that in the future, increased emphasis will be placed on office work as compared to field work, and that the character and amount of the field work required will be determined on a more scientific basis. Under more logical apportionment of the time and aided by modern mechanical devices, workers in the field of forest mensuration should be able to use the powerful tools of statistical method and graphical analysis to make rapid progress in supplying reliable tables as the basis for future forest management.

MEASUREMENT OF YOUNG PLANTATION PLOTS[1]

By Geo A. Mulloy

Forester, Research Division, Dominion Forest Service

Much work has been done by the Dominion Forest Service in the establishment of plantations both in the east and the west. In the east many plots have been established in connection with the planting schemes of the Laurentide Company of Grand Mere, P. Q., at the Petawawa Forest Experiment Station and at the Bathurst experimental area in New Brunswick. In the west planting on the various reserves has been carried on for a number of years.

The method of procedure in the examination and remeasurement of these plantations should be organized so that all experimentation and records will be upon the same basis. It is the object of this article to set forth in detail the methods of examination which will assure a correct record of each plantation's behavior.

We have at our disposal two means with which to measure the relative success or failure of any plantation. These are height growth and mortality. Diameter growth does not become measurable for some time later in the plantation's history and so will not be discussed here. Sturdiness or thriftiness, while a great factor in determining the success or failure of any plantation, especially in the very young stage, is difficult of measurement and at present can not be used as a measure in these studies. The discussion following will therefore deal only with height growth and mortality.

HEIGHT GROWTH

Heights of the small plants in the plantation should be taken during the period when active height growth is not taking place; that is, in early spring or late summer. With the conifers, height growth is probably finished about the beginning of August. Any slight growth which may occur after that will not appreciably affect averages, as the possible error in any one measurement is greater than this growth. If on the other hand record of height is made during the season of active height growth, any remeasurement would have to be made at the same time of year.

It is not necessary to remeasure at one or two-year intervals. Remeasurement should be at five-year intervals. Internode measurements,

[1]This article is based on methods developed by W. G. Wright in his "Use of Statistical Methods in Forest Investigative Work."

however, should be made at these five-year periods, so that a curve of the rate of growth during the preceding period may be constructed.

It is not possible to give absolute directions as to the number of measurements to be taken. Under certain circumstances, it may be necessary to measure all the available material with the possibility that, even then, not enough data will be obtained to give an average of the precision required. The two factors influencing the number of measurements necessary will be discussed below.

The variation in the height of the plants forming the plantation is one of these factors. If the growth of the plantation is uniform many less measurements will be necessary to obtain an average than if it is very uneven. It will be necessary to measure some of the plants before deciding. These measurements will form a frequency group for which the standard deviation may be calculated. Since the standard deviation is an expression of the measure of the dispersion of these measurements, it follows that with a great dispersion, the figure for standard deviation will also be large and vice versa. In the formula used[2] in the calculation of the number of measurements[2] $N = \left(\frac{S_n}{S_e}\right)^2$

Where

N=Number of measurements necessary

S_n=Standard deviation

S_e=Standard error

it can readily be seen that if S_n is large, N also will be large.

In a five-year old plantation of some 6,300 white spruce, all the plants were measured for height. From this data it can be shown that an accuracy in the average height of $\pm$ .13 inches was obtained. That so precise an average is not necessary is apparent when we consider the use which will be made of an average of this kind. It will be used chiefly in comparison with average height of other plantations of the same species on other sites, or of other species on similar sites, to determine the influence of some such factor as variation of site, age of stock, spacing, etc. In any comparison of the average height of two plantations, a difference in height of less than one inch would be meaningless in view of the other unknown factors influencing height growth which are ordinarily not considered, such as insect damage, uneven covering of snow, etc.

[2]Use of Statistical Methods in Forest Investigative Work, by W. G. Wright. Section 22, Formula 9.

It will readily be seen then that very great accuracy in any of the averages obtained, is not necessary. It would seem sufficient to aim for an accuracy of about $\pm$ 1.0 inches in the averages of heights of any plantation. That is if the average is determined to be 16.2 inches, this will mean that the actual average is very unlikely to be less than 15.2 inches or more than 17.2 inches.

Three groups of measurements were selected from the material referred to above. The first group was composed of 163 measurements picked at random; the second group of 216 measurements picked at random from another part of the material; and the third group was composed of the last 300 measurements. For each of these groups a dispersion table was made up and the various means, standard deviations and standard errors, calculated. These are shown in the following table:

Summary of means, standard deviations, standard errors, and limits of error from Groups 1, 2 and 3

Group	No. of Samples	Mean Inches	Standard Deviation	Standard error	Limit of error
1	163	16.23	$\pm$4.29	$\pm$ .34	$\pm$1.02
2	216	16.43	$\pm$3.73	$\pm$ .25	$\pm$ .75
3	300	16.42	$\pm$4.01	$\pm$ .23	$\pm$ .69

It will be seen that the means obtained are practically identical (16 inches) and that with three times the standard error taken as the limit of error, the accuracy obtained is amply sufficient.

Taking the standard deviation of Group 3, ($\pm$4.01 inches) the number of measurements necessary to obtain an accuracy of $\pm$ 1.0 inches can be calculated from the formula $N = \left(\frac{S_n}{S_e}\right)^2$

For a limit of error of $\pm$ 1.0 inches, the standard error must not exceed $\pm$ .03 inches.

Therefore $n = \left(\frac{4.01}{.3}\right)^2 = 177$ measurements.

It seems, therefore, that if the measurements of 200 plants scattered systematically throughout the plantation, had been taken, that an average would have been obtained of the height of the plants in the plantation which was quite accurate enough for our purposes.

In the measurement of the plantation for height it is not necessary to mark the plants measured so that the same ones may be recorded in

any remeasurement. Indeed this is the wrong idea and may give a false idea of the accuracy of the work. Later on in the life of the plantation, the various plants will begin to differentiate into height classes, depending on local differences in growing conditions, or inherent dominance. When the plantation is measured again, if no classification can yet be made into the various crown classes or if the stand has not yet begun to close up and the various trees compete with one another for light and moisture, the same procedure as before should be followed, i. e., some 200 plants scattered systematically throughout the plantation should be measured for height. The calculation may then be made to see if sufficient samples have been taken to ensure the accuracy desired. It may be that more measurements will be needed at the second remeasurement, at the end of five years, than at the first. Thus, it would lead to an erroneous conclusion if only those plants used in determining the first average were used in determining the second.

After the plantation has begun to close up and differentiation into the various crown classes has started, it will be necessary to make some classification as to dominance. Since the standard deviation is a measure of the dispersion of the measurements from which the average is obtained, and since with a great variation in individual measurements the figure for standard deviation will also be large, it follows that the figure obtained for standard deviation will be a guide in determining when classification as to dominance should be made. The number of measurements of dominants, necessary to give an average of the desired accuracy, can then be ascertained by trial.

MORTALITY

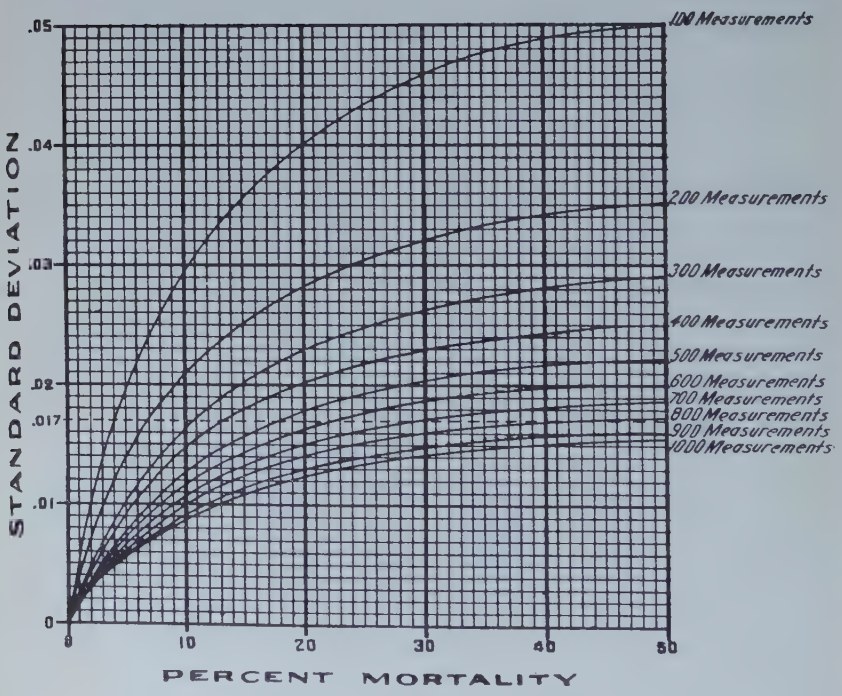
It is clearly not necessary in a large plantation to go through the whole plantation and count all the dead. Some idea of the average mortality can be obtained when measurements are made for height growth. Thus, if, as is indicated in the determination of average height growth, measurements are taken on 200 plants, a record will be obtained of the number of dead plants encountered. Whether this figure can be accepted as a correct measure of average mortality, forms the basis of the following discussion.

As in determining average height growth we must first decide how precise an average is desirable. The factor limiting the accuracy desirable is the use that is to be made of a figure for average mortality. In comparing two or more plantations, as to mortality, it is presumed that the plantations are comparable. Usually variations in mortality be-

tween plots can be, or are ascribed to variations in the action of certain factors, such as drouth, age of stock used, or system of planting. This presupposes that all the factors causing mortality in these two or more plots are known, and are operative in all cases, and that no other agency

GRAPH SHOWING
NUMBER OF MEASUREMENTS NECESSARY FOR
VARIOUS PERCENTS OF MORTALITY
AND FOR
VARIOUS DEVIATIONS

$$S_n = \pm \sqrt{\frac{pq}{n}}$$



causing mortality is operative in one case and not in the others. However, in practical field work such control is impossible. Unknown causes of mortality constantly enter which tend to mask the results of the varying action of the cause of mortality being studied. In view of this, it would not be wise to place much value on a difference of mortality of less than five per cent.

Having determined that an accuracy in the figure for average mortality of $\pm$ 5 per cent is all that is required, it is necessary to develop a measure of precision. We are here dealing with attributes not variables as in the case of height growth, and therefore a different method of handling the work is necessary. The following formula[3] has been developed for the calculation of the standard deviation of the proportion of dead $S_n = \pm \sqrt{\frac{PQ}{n}}$

Where S_n=Standard deviation of the proportion of dead in n measurements.

P =Proportion of dead
Q =Proportion of living
n=Number of measurements.

In this method the standard deviation is the measure of precision and the measure of precision varies as the square root of the number of measurements on which it is based. But it varies also with the proportion of dead and living.

The accompanying graph has been made up by use of this formula, the values of the standard deviations obtained from various numbers of measurements being plotted on per cent mortality.

To use this graph in determining the number of measurements necessary to obtain an average of a given precision, it is necessary to have some previous idea of the mortality. In the example referred to under height growth, it was found that the mortality was about seven per cent. With a limit of error of five per cent (0.05 expressed as a proportion) the standard deviation must not exceed one-third of this or 0.017. Now it will be seen from the graph that the co-ordinates from seven per cent mortality and 0.017 standard deviation, respectively, meet at the 200 measurement curve. Had the mortality been 30 per cent, 700 measurements would have been necessary. The horizontal line drawn from .017 standard deviation indicates the number of measurements necessary to obtain five per cent accuracy for each percentage mortality.

Thus in the example given both the figures for average height and average mortality could have been obtained in this case by an examination of 200 plants scattered systematically through the plantation.

---

[3]Use of Statistical Methods in Forest Investigative Work, by W. G. Wright. Section 13.

In conclusion, the experimenter is warned that, in both the determination of average height growth and average mortality, the methods developed here are only applicable when the conditions are uniform. The whole plantation should be given a rough examination to prevent a misapplication of these methods. For instance, if one part of the plantation is on different kind of soil from the rest, this fact may have a great influence on the height growth of the species being studied. This part of the plantation should be measured separately. Then again it may be found that for some reason all the trees have died in certain restricted patches. In this case again, this part of the plantation should be recorded separately. In other words, the use of these methods in determining the number of measurements necessary to obtain an average of the precision desired, is subject to the three conditions of simple sampling being fulfilled.[4]

[4]Use of Statistical Methods in Forest Investigative Work, by W. G. Wright. Section 12.

GRAZING IN PINE PLANTATIONS

COMMENTS BY J. A. COPE

Assistant Professor of Forestry, Cornell University

"Nouveau frisson" is a French expression that aptly describes the reaction that naturally comes when accepted concepts are overthrown and new and different concepts take their place. Foresters should welcome such changes in the established order when well substantiated by facts, and when such changes make toward better practice and technique in any phase of their profession.

In this latter respect, particularly, it would seem to the writer that the contribution to the December Journal, pages 846-860, entitled "Grazing of Cattle and Horses in Pine Plantations," is debatable and not final.

A principal reason advanced by the authors for the practice of using the same piece of land at the same time for both grazing and tree growing is the temporary reduction of fire hazard. Temporary because, admittedly, as soon as the crown cover closes, the grazing animals necessarily cease to function in this capacity, while the fire danger continues on apace, the dense carpet of needles merely supplanting the dried grasses and weeds as inflammable material, although shade conserves surface moisture somewhat. At its best, then, it is only a stop-gap, and the owner, really desirous of protecting his plantation from fire, would have to make special provision for this, anyway by the 10th or 12th year. With the average farmer who, after all, is going to do the most of the planting on these idle lands, in New York State, as well as southern New England, there is a far better chance to get him to put in fire lines or otherwise provide protection at the time of planting, than after the lapse of a decade.

But to return to the premise, i. e., "the reduction of the fire hazard,"—is it well substantiated by facts? It would seem that the entire emphasis in this study has been placed on proving that grazing did not appreciably damage the plantation and we are expected to assume that the fire hazard is reduced. The moon is not made of rock salt, *ergo* it is made of green cheese!

It is true that Point 1 of the Conclusions (page 858) states that it was noted that grass was shoe high or taller in the ungrazed portion, whereas it was close cropped in grazed portions. But this most im-

portant point is not mentioned in the analysis of the plots studied. There are no facts submitted covering the damage by fires to grazed and ungrazed plantations which would seem most essential to the original premise.

A careful perusal of the article further brings out the fact that in practically every plot studied, the stock was not confined to the plantation but merely had access to it. In plantation A the cattle came in through an opening in the fence. In plantation B access was obtained along a narrow lane. In plantation D there is an opening, and in plantation E the plantation is fenced on two sides only. How can the results be at all conclusive either as regards damage or reduction of hazard, unless:

1. The stock is confined strictly to the planted area.

2. Unless present in sufficient number to close-crop the area in the sole effort of securing sufficient food supply.

As showing the reverse of the picture the following well authenticated experience of Mr. C. G. DuMond of Walton, Delaware County, New York, may be of interest. Mr. DuMond is one of the most interested and progressive woodland owners in southern New York and has carried out a continuous planting program over a 10-year period in which approximately 150,000 trees have been set out.

In the fall of 1914, five acres of pasture land were set out to two-year old seedling white pines using a spacing of six by six feet. In Mr. DuMond's words: "In order to prove to my neighbors who did not share my convictions as to the damage caused to young plantations by cattle, I allowed grazing on about one acre, the remainder of the plantation being protected by a fence. Since then I don't have to talk—I can just bring them over and show them."

For eight successive seasons, 15 head of cattle had access to this one acre as part of a grazing area of some 25 to 30 acres. During this period the cattle were efficient in keeping down the grass but actually destroyed fully 90 per cent of the stand, chiefly by trampling. In 1922, the area was replanted, though the 10 per cent cattle survivals still stand so that he who comes may see.

Conclusion No. 4 (page 859) of the article points out that heavy losses occur on ungrazed sod when seedling stock is used. Practically

all of Mr. DuMond's plantings have been on old fields and pastures and after 10 years' experience he is firmly convinced that two-year old white pine seedlings can successfully compete with grass and weeds, even where it grows knee high, as is the case on practically all his planting sites. In fact he will gladly show you a plantation where seedlings and transplants were set out side by side in an abandoned field and now, after the lapse of four years, he will defy you to tell which are seedlings and which are transplants. You can't—either from height growth or appearance.

ECONOMIC RESULTS OF IMPROVED METHODS OF GRAZING

By John H. Hatton

Assistant District Forester, District 2, U. S. Forest Service

Any innovations or new methods in range or livestock management on the Forests, to succeed and endure, must meet, in the final analysis, the acid test of practical economy. There may be local instances or factors in management where our requirements would spell loss in livestock operations for those particular items, but the sum total of the results must not show in the "red" if we expect stockmen to continue to use the grazing resource and at the same time inaugurate better methods as we see them, or have worked them out. The subject is therefore of first consideration in our range management study and program. It is the hub of the wheel. Our theories must be supported by practical observations and results. Are practical livestock grazing or management and silviculture incompatible under our average forest conditions? If grazing, occupying as it does a secondary place in forest economy, must sacrifice or give way in any items to the other, is that sacrifice counterbalanced, or can it be by a showing of profitable economic results?

Sometimes, however, the stockman reaches the conclusion that it is useless to do the thing demanded of him and he reluctantly carries out instructions, or just gets by, or figures on getting out of the business as easily and quickly as possible. On the other hand, with supporting data to our demands we might easily show that the method or methods it is desired to install for range and forest betterment would be distinctly to his economic advantage and business interest. Nothing will put over our idea quicker than that. We immediately get out of the realm of gambling (which is pretty prominent in the stock business anyway) into one of fact and assurance and basic knowledge. We can begin to figure ahead. Thus we are in a position to inject into the stock business something that is very much needed—the habit and practice of using business methods and foresight—of putting things to the test of cold figures.

We think of grazing and forest reproduction as the outstanding issue. In a sense it is the outstanding issue if it is an open and shut

question of one or the other and we know whereof we speak. We regard lambing and too heavy sheep grazing in the yellow pine type as injurious. We know in an abstract or general way, and from concrete studies in certain forests, that these uses may be injurious to young trees; that improved grazing management will doubtless eliminate or curtail or control such uses as rapidly as possible in particular types of forest. But even in this instance there are the questions of total exclusion or light uses and whether or not it might not be more economical to the sheepman if he would conduct his lambing operations at lower altitudes outside the forests, and under more intensive conditions. While often a difficult administrative problem is introduced when we decide to "close shop" on lambing grounds, by simply stating "you must make other arrangements next year, or within the next five years," that problem, even, might be greatly simplified if we had data to show that possibly it would be to the economic advantage of the sheepman to dispense with his high altitude lambing and make other arrangements. The Cochetopa Forest for the year 1923, for instance, shows that the sheepman would benefit to the tune of 12 per cent better results at lower altitudes, other factors being the same. This observation would have been impossible without concrete facts collected in the course of our regular work. If we can prove this point economically for our average lambing conditions, then it would appear, with the studies that have been made on other phases of grazing use, that there is practically no phase of forest grazing management that will not lend itself to constructive study or to the acid test of economic results.

It behooves us, therefore, to substitute for our general observations and demands concrete data and facts. We should give the stockman, and I think this possible in most cases, an economic reason for our demands upon him, and back up the "hope that is within us" as rapidly as possible with supporting facts. Such expressions as "the range was overgrazed but not permanently injured" must be supported by that permanent sample plot to show whether a given palatable species is going to hold its own, or whether inferior and unpalatable species are displacing it. Here the economic phase to the stockmen should not be difficult to visualize. Certainly in the long run it will be more profitable to him to so graze as to preserve the basic forage crop. Is it more profitable, in figures, to do any of the things the Forest Service advocates under the title "improved methods in range management?" Data are

available from general or widely separated studies, but we make little use of them. We can tell a stockman that over in the Bighorn Forest in Wyoming such and such figures were obtained showing the advantages of open herding, but it's like reading the headlines of a newspaper. The item that catches our eye and attention is the one which starts John Jones, Durango, January 2; or Mancos, January 3; or Glenwood Springs, January 10; or Denver, February 1. Chicago, New York and Boston are too far away in most cases to hold our attention to the end, or perhaps to attract our attention at all. Every forest and ranger district should start a home news sheet, so to speak—a daybook of concrete observations and comparative data for ready reference which will expel doubt and fix facts. I remarked to my wife that I didn't think the chickens had paid the year 1923, but I had kept accurate figures which when analyzed showed a profit of 92 per cent on the investment. It would have been difficult for me to accept that as a general conclusion without supporting figures carefully kept through the year. The stockman does not automatically keep figures. They must be obtained for him or he must be directed in their collection and use. I can see no other one way to inject a sustained, vital, enthusiastic close-to-home interest in our grazing management and in our new problems, both to forest officers and the range stockmen. I can think of no single factor which will so quickly put over the things that widely scattered studies and observations have suggested as advisable. I can think of no better way to put new life and interest into that document we call the annual grazing report. "Figger or fail" is a slogan we might very profitably adopt in our livestock and range management program, and, supported by the objectives which are now pretty universally in mind, who can measure the progress that will be made or the new interest which will be aroused in a subject that has always carried a more or less instinctive appeal to the average forest officer?

Summed up and viewed from the generally unsatisfactory conditions of grazing before the ranges were put under control, it is believed we can show for the great majority of our conditions that better methods designed to improve forest and forage conditions can be shown to be of economic advantage to the range users, and this, supported by concrete data obtained "at home," will carry our program of improvement most rapidly forward. The hard taskmaster or unsuccessful teacher is he who because of a general policy or instruction attempts to put over an idea without fortifying himself with basic knowledge or facts. He does

not separate the essential from the non-essential. He not only is apt to make unreasonable and unjust demands but he does not get a hearty nor lasting response. His user will not warm up to him nor lodge confidence in him nor the service or program he represents. Our problem is mutual as between forest officers and stockmen, with the forest officer taking an active and intelligent lead as he familiarizes and fortifies himself with workable facts. And lastly, let us not forget to cultivate a sincere, personal interest in the individual stockman's business and his problems. Our range uses are perhaps among the most human we have—at least they offer the best opportunities for real, human, man-to-man contact and mutual understanding and cooperation.

GATHERING AND EXTRACTING RED PINE SEED

By Arthur Herbert Richardson

Forest Engineer, Canada

Red pine is rapidly becoming one of the most important species for reforesting work in Canada and the north-eastern United States. White pine has been somewhat in disfavor of late years with tree planters, owing to the injury done by weevils and the blister rust. It is also a little more tender than red pine and prefers better soil conditions. But even if this were not so, red pine would still be a worth-while tree to plant, as it grows well on light soil and is of good commercial value. But the one drawback in the use of this tree, at least at present, is the cost of seed. This was quoted last winter in New York at $21.00 per pound, and Mr. Keller of the Pennsylvania Forest Service, writing in the Journal of Forestry recently, stated that it had been quoted as high as $36.00 per pound. At such prohibitive prices it will not be surprising if production of seedlings of this species should fall off; but such prices are unnecessary, for during the autumn of 1923, the writer supervised the gathering and extracting of over a ton of red pine seed at a cost of $4.75 per pound. It is possible that this amount can be exceeded in another good seed year, but as the Ontario Forestry Branch has not as yet gone into the business of selling seed, we gathered only what was needed for two seasons' work.

The seed, as is usually the case in a good seed year, was of first-class quality, averaging 50,624 seeds to the pound, and a germinating per cent of 87.12 based on 87 tests of 100 seeds each. (All tests mentioned in this paper were conducted by the Seed Branch, Dominion Department of Agriculture, using the Jacobson method with 100 seeds for each test.)

GATHERING

The area from which cones were received covered roughly that part of Ontario south and east of Lake Nipissing, but the great majority of them were gathered from a sand plain area of about 50 square miles. For the larger area, advertising was done by means of printed circulars and posters and through the local papers, and freight was paid on shipments of ten bushels or more from these outside points. Such shipments accounted for 337 bushels; the remainder of the 3,127 gathered, came from pickers in and around the village of Angus where the extracting plant is situated.

The surrounding country here is composed of a sand plain from

which the pine, both red and white, was removed 40 to 50 years ago. Today, a great deal of it is treeless barrens with here and there clumps of red pine 30 to 40 years of age, widely scattered, with large rounded crowns, the ideal form for cone production.

Help for gathering cones was obtained almost entirely from the surrounding country. Usually in such localities the people who live there are willing to gather cones and in this way earn some ready cash. In addition to this help, a small camp of 6 to 10 men was conducted by the Ontario Forestry Branch, made up for the most part, of students. These worked under the same conditions as the local help and were charged a nominal amount for their board. In addition to doing the regular cone-picking work, they were also a means of securing quantities of other seed and for determining the amount of any species a man could pick in a day.

All picking was done on a piece-work basis, and the price per bushel dry measure throughout the season was two dollars. Picking bags of canvas, with open tops, hooks for pulling in branches, and jute sacks for bringing in the cones were supplied free to any one who wished to pick. Conveyances were supplied for villagers who had no way of getting to the pine groves and cones were called for either in the woods or at the homes of the pickers by government trucks.

As a careful record was kept of cones brought in by each individual it was a simple matter to determine what constituted a fair day's work. Four men who had had no previous experience and who gave all their time to the work, averaged each for 22.5 days, of 9 hours work, 2.71, 2.05, 2.02 and 1.83 bushels of cones respectively, or an average for the four of 2.15 bushels per day. This was during the best part of the picking season and includes six rainy days, when, of course, no picking was done. It will be seen, therefore, that two bushels per day on an average represents what a picker may reasonably expect to get, which at $2.00 per bushel gives a wage above the average per day in the rural communities of Ontario.

The above figures represent hand picking entirely. No squirrel hoards were included in the quantities as the squirrels had not commenced to cut down the cones while these men were picking. Later on large quantities were sometimes taken from hoards, the largest ever reported being sixteen bushels.

CURING

When the cones were received at the plant they were measured with a standard bushel measure, filled to a rounded top and containing on an average 1,644 cones (based on two countings). And as all the measuring was done by the same man throughout the season, the quantity each time was uniform. The cones were then cured indoors or outdoors and both by natural means.

If to be cured indoors they were emptied on a tight floor in a loft with good circulation and left there until wanted at the extracting plant, curing taking on an average of two weeks. If to be cured outdoors they were spread on sheets of burlap 30x40 feet and exposed to the elements until cured. This took from one to three weeks depending on the weather, the scales being opened somewhat and thoroughly dry. They were then bagged up and stored for winter extracting.

As will be seen from Tables I and II no appreciable difference in quantity or germinating per cent of seed yielded from cones treated in these two ways was recorded. Providing the cones were fully formed and not heated in transit, it made little difference whether they were gathered at the first of the season or at the end, or whether cured indoors with only warm air, or outdoors with sun, rain and frost. Indoor curing is, however, more satisfactory as it can be controlled. With outdoor curing it may rain intermittently for weeks which delays the work of extracting. This is an important matter when seed is to be supplied for autumn sowing. Furthermore, outside curing requires a large outlay for burlap sheets which last not more than three years. Bags must also be purchased for storing which, besides the work of bagging, adds to the cost. Then also, where curing is being done near the picking area there is the possibility of theft. Squirrels carry off some cones and frequently flocks of migrating birds eat considerable quantities of seed.

EXTRACTING

The building in which the extracting is done is a three-story frame structure. One end of the middle floor is partitioned off as a heat chamber with trap doors opening from the floor above for feeding and with two hoppers which hang into the room below. Eight hexagon-shaped, wood framework drums are used, six feet by three feet and covered with heavy steel screening, one full side forming the door. These are arranged in two horizontal rows, the four top ones being fed directly

from above, the four lower by means of curved iron chutes. Vertically the chamber is divided by a wire screen partition, with four drums in each side. This does not interfere with heat circulation yet permits of extracting two different species of cones at once. Each section opens into a separate hopper with mouth three feet from the floor below. Heat is supplied by a wood burning furnace which stands between the two hoppers on the cellar floor. A cold air shaft, the size recommended by the manufacturers of the furnace, opens one foot below the bottom drums on the heat chamber wall and drops to the floor below. This gives a continual circulation of warm air and is more satisfactory than if the heat rises to a dead chamber. When air is hot and stagnant cones have a tendency to cook which causes them to become brittle and break off into the seed. Sliding windows eight inches square are provided for filling and emptying. The drums are turned by man power with a crank outside the chamber partition, the top row being turned from a movable platform. It will be seen, therefore, that it is not necessary to enter the heat chamber during the extracting process, except in case of emergency, everything being done through small doors. This conserves heat.

The actual process of extracting the red pine seed occupies one full day of ten hours. Each day a quantity of cones sufficient to fill all the drums, is brought in from the storehouse, which is usually at a temperature of below zero, where they have lain for months, not having been touched since curing. These are placed on the floor above the extracting chamber and allowed to warm up. In the morning all the drums are filled, which requires approximately 24 bushels of cured cones. They are then all turned, by two men, 25 times. The seed coming down at this first turning is really naturally extracted seed, and as seen by Table I, is by far the largest amount coming down for the day. Its germinating per cent, however, as seen by Table II, does not differ appreciably from that which comes down later in the day. At intervals of a half hour throughout the day the drums are all turned 25 times and the seed drawn off. It was found that continuous turning rattled the cones too much and had a tendency to break the scales. Intermittent turning is just as effective and allows time for making fire, cleaning the seed and doing odd jobs around the plant.

As there is a difference of five to eight degrees in temperature between the lower and upper drums, the cones in these are interchanged

TABLE I

To determine the quantity of seed released from cones each hour during the extracting period and the yield per bushel of cones

Hour Taken	13½ Bushels Cured Indoors			13½ Bushels Cured Indoors			13½ Bushels Cured Indoors			Average of First Three			3,127 Bus. All but 50 Cured Outdoors
	Lbs.	Ozs.	Per Cent	Lbs.	Ozs.	Per Cent	Lbs.	Ozs.	Per Cent	Lbs.	Ozs.	Per Cent	Lbs.
9 A. M.	4	14.50	44.22	4	13.00	48.78	6	09.00	60.31	5	06.88	51.10	
10 A. M.	1	00.00	9.01		13.25	8.43		11.75	6.74		13.60	8.06	
11 A. M.	1	00.50	9.29		13.50	8.59		09.25	5.31		12.96	7.73	
12 Noon		14.25	8.02		11.50	7.32		07.50	4.30		11.04	6.54	
1 P. M.		10.00	5.63		7.25	4.63		05.75	3.29		7.68	4.51	
2 P. M.		09.00	5.07		5.50	3.53		06.75	3.86		7.04	4.15	
3 P. M.		12.25	6.90		7.25	4.64		11.50	6.59		10.40	6.04	
4 P. M.		10.25	5.77		7.50	4.80		07.25	4.15		8.32	4.91	
5 P. M.		5.25	2.95		6.00	3.83		04.50	2.56		5.28	3.11	
6 P. M.		3.25	1.83		4.25	2.70		03.25	1.86		3.52	2.03	
8 A. M. next morn.		2.25	1.26		4.25	2.70		01.75	1.00		2.72	1.65	
Total	11	01.50		9	14.00		10	14.08		10	09.60		2,383.5
Ounces per Bushel		13.14			11.70			11.85			12.55		12.19

TABLE II

Germinating tests of 100 seeds from cones cured in different ways

	1	2	3	4	5	6	7
Hour Taken	Cured Indoors	Outdoors Rained on Severely	Outdoors Average Cones	Outdoors Picked Late	Outdoors Picked too Early	Outdoors Heated in Transit	Outdoors Discarded
Average of	3 Tests	1 Test	3 Tests	1 Test	3 Tests	2 Tests	10 Tests
9 A. M.	88.0	91	81.6	86	10.6	20.5	
10 A. M.	87.6	89	87.0	92	16.3	45.5	
11 A. M.	86.0	88	81.3	94	23.6	48.0	
12 Noon	90.0	95	83.3	87	29.3	26.0	
1 P. M.	86.0	91	86.6	85	31.3	29.0	
2 P. M.	88.7	89	81.6	86	25.6	56.0	
3 P. M.	93.3	93	84.0	86	21.3	40.5	
4 P. M.	88.3	95	85.6	91	12.6	49.5	
5 P. M.	88.3	91	83.3	87	9.0	47.0	
6 P. M.	83.7	82	81.0	82	8.0	40.2	
8 A. M. next morn.	83.7	87	80.0		4.0		
Average for each class	87.6	90.09	83.2	87.6	17.41	40.2	24.9

Average for 1, 2, 3, and 4—87.12.

after the noon hour. This accounts for the increased amount of seed coming down at the three and four o'clock periods, (Table I) and also for the drop in temperature at the same hours on the heat chart.

At six o'clock, and quitting time, the drums are turned for the last time that day. The cones are left in over night in order to take advantage of the heat still in the chamber. Next morning the drums are turned once more, the cones emptied out and discarded.

TEMPERATURE

The amount of heat which seed of different trees will stand is an important factor in extracting. Experiments have shown that red pine will stand a temperature of 150 or 160 degrees Fahrenheit without injury. When, however, it was found that the extracting period had to be one full day, it was decided that for economy in seed germination as well as for fuel, the temperature would be held only sufficiently high to extract the seed. This was found to be 130 degrees Fahrenheit, and as a thermometer was placed at a window on a level with the cones in each drum, it was a simple matter to regulate the heat.

It is interesting to see in Table II that although the seed was exposed to this temperature for ten hours there is no appreciable difference in the germinating per cent between that taken first and that taken last, both being near the general average of 87.12 per cent.

Tests were also made to determine the amount of seed yielded by an exact number of bushels of cones, cured (indoors for accuracy) and extracted by these methods. This, as shown in Table I, was 12.55 ounces. The amount of seed per bushel of cones based on the whole crop was 12.19 ounces, the slightly lower amount being accounted for by outdoor curing—that is, theft by squirrels and birds.

The continual exposure to high temperature, of course, is the means of releasing the seed, and this is done gradually as shown by Table I until the amount at the last turning becomes quite small. When the cones were discarded, however, it was found that they still contained some seed. To determine how much and the quality, ten bushels of these cones were taken one from each day and placed in the hottest part of the extracting room for three days. At intervals they were taken out and hammered in a bag and broken up to get every seed. From these 10 bushels all told, only seven ounces of seed were obtained with a germinating per cent of 24.9.

SUMMARY OF COSTS

Purchase of cones, 3,127 bushels @ $2.00 per bushel		$ 6,254.00
Advertising		258.49
Fuel		88.50
Camp expenses		162.43
Wage of three workmen—measuring, curing and extracting cones, erecting and dismantling camps. Doing necessary repairs to buildings and machinery during season		3,292.54
Wages of foresters		300.00
Misc.—including freight, express, postage, etc		607.25
Depreciation of equipment other than buildings valued at $2,000		350.00
Total		$11,313.21
Number of pounds of seed	2,383.5	
Cost per pound		$4.75

REVIEWS

"Western Forest Trees," By J. B. Berry, World Book Co., Chicago, 1924. Pps. XII+212.

Professor Berry has previously issued a book on Southern Forest Trees, reviewed in the Journal of Forestry for October, 1924. These dendrological handbooks are intended to accompany the author's "Farm Woodlands."

The book on Western Forest Trees is based largely on Sudworth's "Trees of the Pacific Slope," being popularized and simplified for the non-technical student. The book is attractively prepared with excellent photographs and cuts. There are a few minor technical errors such as placing tanbark oak in the genus *Quercus.*

The book divides into a brief introduction on how to identify trees and woods, followed by detailed description of the needle leaf trees and the broadleaf trees.

For the field it covers, the book serves a very useful purpose.

A. B. R.

"The Forests of Finland—The Forest Resources and the Condition of the Forests." (A paper discussing the main results of the General Forest Survey.) By Yrjö Ilvessalo.

Ilvessalo is to be congratulated on an admirable preliminary forest survey summarizing "Forest Resources and the Condition of the Forests of Finland." In view of the Finnish loans which are now being discussed in New York, this bulletin of forest resources is extremely timely and was justified by the inaccuracies of former statistics. The survey was by means of strips run southwest to northwest over the whole of the forested area, each about 26 kilometers apart. The author claims this method is accurate enough and has some interesting data on accuracy based on the calculus of probability.

The total land area was divided into four main classes: (1) Productive forest land, (2) forest land of poor growth, (3) waste lands and (4) cultivated, etc.

The results of the survey may be summarized as follows:

The productive forest land is 58.6 per cent of the total land area (Zon's figures were 45.6 per cent) and amounted to about 50,000,000 acres (Zon's figures were 37.5 million.) The total forest land occupies 73.5 per cent of the country (Zon's 91.5 per cent). Judging from these figures Sparhawk & Zon will have to revise the statistics on Finland

in the next edition of "Forest Resources of the World." The forest area per capita is about 18 acres and the ownership is 51.7 per cent in private hands and 39.9 per cent under the state. Joint stock companies own 6 per cent, state fief lands 0.9 per cent, ecclesiastical fief land 0.9 per cent and communes 0.6 per cent. The chief species are pine and spruce in four-fifths the forest area with birch alder, aspen and other broadleaf trees dominating the remainder. The author gives the age class distribution, the growing stock, and the annual growth. With 1,620 thousand cubic meters growing stock and 44.4 thousand cubic meters of annual growth, apparently the average growth per cent for the whole country amounts to 2.7, an interesting figure considering the northern climatic conditions that exist in Finland.

The appendix shows the location of the survey lines and gives all statistics in colored diagrams in a most pleasing and up-to-date manner. It is a high class publication evidently prepared with great care.

T. S. W., Jr.

"Défense des Forêts Contre L'Incendie. Rapport Fait au nom de la Commission technique temporaire des Incendies de Forêts." Par M. Antoni, Inspecteur Général des Eaux et Forêts.

Owing to heavy fire losses the French Government appointed a distinguished commission to inquire into (1) the causes of these fires, (2) preventive measures, (3) measures preparatory to fighting fire, (4) fire fighting and (5) improvement of burned forests. All those engaged in teaching fire protection in American Forest Schools should be sure to get a copy of this interesting bulletin compiled by Antoni, Inspecteur Général of French Forests, who was President of the Commission.

The report contains much of interest on the subject of intensive fire protection, but few of the measures advocated would be applicable in the western United States. Of especial interest is a statement of examples of railroad protection: In the Landes the local railroad clears an outer guide line of all vegetation from June 1st to October 1st, and provides a special fire lookout for each three thousand feet of track, evidently an exceedingly costly measure. Another example of a railroad right of way cleared for fire prevention is the Forest of Mormal between Valenciennes and Aulnoye where the fire line is 9 feet in width 20 to 30 yards from the track with radial 4.5 foot lines every 150 feet. Much of the discussion of fire protective measures is suggestive of measures that might be employed under intensive conditions in the

United States. But on the whole, American fire protective technique is ahead of the best that is known in France. Naturally the substitution of known inflammable species is too intensive for our conditions, but much of the planting that has been done in the eastern United States violates the first principles of fire protection, namely, "the creation of strips of broadleaf trees in coniferous stands." Nor can we introduce what the French call "d'essences reafractaires a l'incendie," as an understory until forests become even more valuable.

T. S. W., Jr.

"The Role of Fire in the California Pine Forests," by S. B. Show and E. I. Kotok, Forest Service, U. S. Dept. of Agriculture.

This timely bulletin will sound the death knell of those who advocate the "light burning" theory for California forests. It is an unusually efficient publication, mature, masterly and a credit to the Forest Service, to District 5 and to the authors. They inquire into the causes of the "broken, patchy, understocked stands, worn down by the attrition of repeated light fires." They pile up statistics and figures to show the damage from fires both in the virgin forests and in immature stands. My judgment is that their data is incontrovertible. They paint a picture of fire scars, loss to mature timber, reduction in grade, susceptibility of various species, ground injuries, slackened growth as well as a picture of the indirect physical damage to mature timber through insects and fungi which follow the fire. The figures they present on the damage to young growth are particularly effective. Any one who studies such tables as those given on page 27 of the bulletin would be foolish to deny their significance. They show the hazard of crown fires, the complete destruction of second growth stands, the effect of repeated surface fires, fire damage on cut-over areas, effect on reproduction. Their pictures and descriptions of brush fields are an amazing memorial to California's foolishness and perhaps I should say insanity.

As benefits of light fires they mention the natural thinnings that may result, but in the opinion of the reviewer the dangers are greater than the benefit.

At the end of the bulletin is an excellent summary which every forester in the United States should read. I quote a few conclusions:

1. "Fire in the virgin forests, in restocking brush fields, and on cut-over lands is important not only in the loss of timber resources it causes, but also because each fire paves the way for greater and more serious losses from subsequent fires.

2. "Fires in the virgin forests of the California pine region rarely are catastrophes, for they do not wipe out at one stroke the entire stand over a large area. Indeed, they are generally distinguished by the fact that much of the damage is relatively inconspicuous and not immediately evident.

"The rapidity with which the processes of acceleration and attrition operate to reduce the virgin forest to a non-timber-producing chaparral area varies widely, depending on a large range of factors, the most important of which is site quality.

"Through site deterioration effected by centuries of acceleration of fire damage and attrition from fire injury, the forest of today has assumed a definite character very different from what it is popularly supposed to be.

"Some beneficial uses of fire appear. Instances have been mentioned in which fire has beneficially thinned out young growth or assisted reproduction in other ways, purely by chance or accident."

"That maximum protection or fire exclusion inevitably increases hazard by the encouragement of undergrowth is, of course, true, but such added hazard in no way vitiates the reasons for protection. It is an additional danger, but one that can willingly be accepted.

"Uses of fire which are contrary to the interests of the forest, such as the firing of the forests or reproducing areas for grazing purposes, are incompatible with timber growing.

"Much of the progress of forest management and of fire protection itself thus depends on a thorough knowledge of fire damage.

"The present values of second-growth timber and the trend of prices upward, as well as the obvious future needs of the country now compel consideration of adequate protection, as a precautionary measure for the private owner, and as a public necessity."

There is very little to criticize in this splendid bulletin. But I wonder why in plate 14 the dead snags are left standing after a timber sale.

T. S. W., Jr.

"*Von Mantel's Formula.*" Indian Forester, December, 1924, pp. 645-647.

Sir William Schlich argues against using the various new formulae that have been suggested to replace the standard Von Mantel's formula so well known to foresters. Schlich illustrates his letter with an interesting diagram and makes it clear that the Von Mantel formula is only a makeshift and that "really accurate determination of the yield

can be secured in the case of irregular forests *only* by periodic re-measurement, say after 10 years in the first place and somewhat longer intervals afterwards." He also drives home the policy of only cutting the full increment if the growing stock is fairly normal and that the cut should be less than the growth if the increment is deficient and more than the growth if there is an excess volume on the ground.

T. S. W., Jr.

"Aero-Surveys in British India." Indian Forester, December, 1924, pp. 605-616.

Blanford describes in considerable detail an interesting and successful aero-survey of over a thousand square miles of the level Irrawaddi Forest of Burma. These forests are chiefly of kanazo, mangrove, and low scrub jungle. In addition to these three types, there are also kanbala, mandama, kanyin, and grassy.....

The area had been mapped by a reconnaissance survey on a scale of four miles to the inch in 1864, and since that time portions of the area had been re-mapped, but without full success, because of the difficulties of a ground survey; wide water-ways, rapid tide, mud banks, inundated land, small creeks, dense undergrowth, bring up the cost of a ground survey to at least $160 per square mile. This country, on the other hand, was found to be ideal for an aerial survey; level, large rivers for safe landing places, distinctive types and a large number of small creeks that would be visible from the air.

The contract for the aero-survey undertaken was slightly over $90 per square mile for a thousand square miles with $9,000 additional in case 350 square miles should be added. The scale finally adopted was 3 inches to the mile and the contract conditions may be summarized as follows:

Trigometrical points to be fixed by the Indian Survey Branch; vertical and oblique photographs are to be submitted to enable compilation of a forest map; vertical photographs to show both banks of all water channels; negatives were 5 by 4 inches; overlaps to be at least 20 per cent; departure from mean height not to exceed one per cent; tilt in no case to exceed three per cent; quality of photographs must enable picking out all details necessary and photography to be carried out at about the same time each day; vertical photographs to be taken to enable proper compilation of vertical views and negatives to become the property of the government of Burma; two prints of all photographs to be supplied.

The work was successfully carried out and the final cost including ground work amounted to about $97 per square mile as against the cost of the ordinary survey of $160 per square mile. The survey was completed in five months whereas a survey on the ground would have taken from three to four years. Much greater accuracy was secured by the aerial survey and "The areas and distribution of the different types of forest are not only obtainable at no increase of cost, but with an accuracy that it would have taken years and considerable expenditure to have equalled."

The sample photographs which accompanied the article are amazingly clear and satisfactory. T. S. W., Jr.

"Adolf Dal: Da Hifjeldsvidderne var Skogkladde—(When the High Mountain Wastes Were Forest-Clad.)" Tidsskrift for Skogbruk. Dec. 1924, 32 Aarg. P. 576.

At a large number of stations in Norway old pine (*P. sylvestris*) stumps and roots have been observed far above the present tree line on the mountains. Roots and trunks lying in water or marshes at altitudes of 12-1300 meters (3,900-4,200 ft.) above sea-level are of rather common occurrence, although the present altitude limit for Scotch pine is not over 900 meters (2,950 ft.) in the same region in southern Norway.

While it is probably true that heavy cutting in the vicinity of high-lying summer farms has lowered the tree limit in many places, and seedlings have been eaten by animals, wild and domestic, the author believes underlying climatic changes to be chiefly responsible for the lowering.

In support of this theory the author shows that lumbering on a large scale is of comparatively recent development in this region, and can not account for the disappearance of tree growth at high elevations before the memory of man. Scotch pine requires a minimum mean summer temperature of 8.5° C. (45° F.) in its extent northward and westward; this temperature is found at 900 meters. Hence the deduction that the climate has been more favorable in the past during one of the warmer cycles following the last glacial period. Oak, ash, maple and hazel had then a much wider range to the north than now, and a mean summer temperature favorable to pine may then have reached as high as 1,400 meters. The author places this time at about 6,000 years ago, and the fact that the pine remains found have lain in cold water accounts for their preservation.

H. I. B.

CURRENT LITERATURE

Compiled by Helen E. Stockbridge, Librarian, U. S. Forest Service.

LIST FOR JANUARY, 1925

(Books and periodical articles indexed in library of U. S. Forest Service.)

Forestry as a Whole

Proceedings and reports of associations, forest officers, etc.

Hongkong—Botanical and forestry dept. Report for the year 1923. 18 p. Hongkong, China, 1924.

India—Forest dept. Annual return of statistics relating to forest administration for the year 1922-23. 31 p. diagr. Calcutta, 1924.

India—Jammu and Kashmir—Forest dept. Progress report of forest administration for the year 1922-1923. 75 p. Lahore, 1924.

New South Wales—Forestry commission. Report for year ended 30th June, 1924. 15 p. Sydney, 1924.

Society of American foresters. Members of the society. 33 p. Wash., D. C., 1924.

Vermont—Commissioner of forestry. Biennial report, 1922-1924. 56 p. pl. Montpelier, 1924.

Washington—Dept. of conservation and development—Division of forestry. Nineteenth and twentieth annual reports for the period commencing Nov. 1, 1922, and ending Nov. 30, 1924. 51 p. illus., pl. Olympia, 1924.

Forest Description

Cubitt, G. E. S. Forestry in Brunei and Labuan: a statement compiled for the British Empire forestry conference, Canada, 1923. 7 p. Singapore, Govt. printing office, 1924.

Deam, C. C. Guide to Clark county state forest. 26 p. pl. Indianapolis, 1923. (Indiana—Dept. of conservation. Publication no. 36.)

Silvical Studies of Species

Dole, E. J. Studies on the effects of air temperature and relative humidity on the transpiration of Pinus strobus. 39 p. pl., diagrs. Burlington, 1924. (Vermont—Agricultural experiment station. Bulletin 238.)

Ellsworth, R. S. The giant Sequoia: an account of the history and characteristics of the big trees of California. 167 p. pl. Oakland, Cal., J. D. Berger, 1924.

Merrill, P. H., and Hawley, R. C. Hemlock: its place in the silviculture of the southern New England forest. 68 p. pl., map, table. New Haven, Conn., 1924. (Yale forest school. Bulletin no. 12.)

Forest Protection

Fire

Clearwater timber protective association. Eighteenth annual report. 24 p. Orofino, Idaho, 1924.

New Hampshire timberland owners' association. Fourteenth annual report, from Nov. 30, 1923, to Nov. 30, 1924. 10 p., Berlin, N. H., 1924.

Potlatch timber protective association. Combined annual reports, 1923-1924. 51 p. Potlatch, Idaho, 1924.

St. Maurice forest protective association. Twelfth annual report, 1923. 16 p. illus. Three Rivers, Que., 1924.

Forest Economics

Taxation and tariff

New Zealand—Timber royalties commission. Report. 20 p. maps. Wellington, N. Z., 1924.

Forest policy

Connecticut forestry association. A forest, park and wild life conservation program for Connecticut. 16 p. New Haven, Conn., 1925.

Forest Administration

Queensland—Dept. of public lands. Regulations under the state forests and national parks act of 1906. 10 p. Brisbane, 1924.

Forest Utilization

Wood-using industries

Canada—Dominion bureau of statistics—Forest products branch. The pulp and paper industry, 1923. 81 p. Ottawa, 1925.

Canada—Royal commission on pulpwood. Report, 292 p. diagrs. Ottawa, 1924.

International paper company. Annual report, 1923. 35 p. pl., map. Corinth, N. Y., 1924.

Auxiliary Subjects

Public lands

Hibbard, B. H. A history of the public land policies. 591 p. maps. N. Y., The Macmillan co., 1924.

Ecology

Clements, F. E., and Weaver, J. E. Experimental vegetation: the relation of climaxes to climates. 172 p. illus., pl., diagrs. Wash., D. C., 1924. (Carnegie institution of Washington. Publication no. 355.)

Clements, F. E., and Goldsmith, G. W. The phytometer method in ecology: the plant and community as instruments. 106 p. pl., diagrs. Wash., D. C., 1924. (Carnegie institution of Washington. Publication no. 356.)

Periodical Articles

Miscellaneous periodicals

Angora journal, Jan. 1925.—Live stock on ranges of national forests, by W. C. Barnes, p. 23.

Arkansas conservationist, Jan.-Mar. 1925.—The conservation of forest resources in Arkansas, by A. C. Millar, p. 3-4; Misuse and abuse of timber resources, by H. Lewis, p. 8, 13.

Breeder's gazette, Jan. 22, 1925.—Grazing fees in range states, by W. C. Barnes, p. 80-1.

Gardeners' chronicle, Dec. 6, 1924.—The pine Chermes in the royal gardens of Kew, p. 388-89.

Gardeners' chronicle, Dec. 20, 1924.—The eucalyptus Psylla, by G. F. Wilson, p. 425.

Journal of land and public utility economics, Jan. 1925.—Forestry and land development in the lake states, by R. Zon, p. 36-43.

Military engineer, Jan.-Feb. 1925.—Future timber supply of the south, by J. H. Pratt, p. 69-74.

Outdoor America, Jan. 1925.—Preserving the Kaibab deer, by W. B. Greeley, p. 31-3, 58; Let's go, by H. Titus, p. 56.

Outdoors pictorial, Feb. 1925.—The Shenandoah as a new national park, by H. O. Bishop, p. 4-5; America's oldest mountains in Wichita forest, by S. M. Shanklin and J. E. Scott, p. 12-13.

Popular mechanics, Jan. 1925.—Model of forest built from fossils shows tree life centuries ago, p. 55; Tractor, saw and stump puller reclaim land, p. 57.

Popular mechanics, Feb. 1925.—Big trees that baffle inventors cut by old-time "buckers," p. 235; Ply board to solve lumber shortage, p. 281-2; Plastic wood is worked like clay: holds nails when dry, p. 288.

Queensland agricultural journal, Dec. 1924.—Queensland trees: Diploglottis cunninghamii, by C. T. White and W. D. Francis, p. 444-6.

U. S. Dept. of agriculture. Journal of agricultural research, July 1, 1924.—Egg and first stage larva of Tarsostenus univittatus (Rossi), a beetle predacious on powder-post beetles, by R. A. St. George, p. 49-51.

U. S. Dept. of agriculture. Journal of agricultural research, Aug. 15, 1924.—New termites and hitherto unknown castes from the Canal Zone, Panama, by T. E. Snyder, p. 179-93; The growing season of western yellow pine, by G. A. Pearson, p. 203-4.

U. S. Dept. of agriculture. Monthly weather review, Oct. 1924.—Why an oak is often struck by lightning: a method of protecting trees against lightning, by R. N. Covert, p. 492-3.

Trade journals and commerce reports

American lumberman, Jan. 10, 1925.—Chicago's biggest year in lumber traffic, p. 38-9; Movement and prices of principal woods during 1924, p. 40-2, 69.

American lumberman, Jan. 17, 1924.—Profits from second growth timber, p. 71.

American lumberman, Jan. 24, 1925.—Europe growing timber for American use, p. 34-5.

American lumberman, Jan. 31, 1925.—California pine and American lumber standards, by E. P. Ivory, p. 49.

Canada lumberman, Jan. 1, 1925.—Urgent need for better fire protection, by D. R. Cameron, p. 46-8.

Canada lumberman, Jan. 15, 1925.—We must keep our wood-using industries in Canada alive, by E. Wilson, p. 39; Vast resources of the old province of Quebec, p. 63-7; Our Canadian forests must be kept green, by J. G. Ross, p. 75.

Four L Bulletin, Jan. 1, 1925.—The Est log raft, p. 10, 46; Dyeing trees as they grow, p. 47-8.

Hardwood record, Jan. 10, 1925.—How growth affects quality in hickory and ash, by B. H. Paul, p. 15, 25.

Lumber and veneer consumer, Dec. 30, 1924.—Chestnut blight to be discussed by foresters, p. 13-14.

Lumber and veneer consumer, Jan. 30, 1925.—A reasonable plea for blue-stained lumber, by C. B. Harman, p. 31.

Lumber manufacturer and dealer, Jan. 9, 1925.—What industry and government are doing in Canada to assure future forests, by E. L. Chicanot, p. 43-4; Our government, the lumber industry and the Concatenated Order of Hoo-Hoo, by J. H. Allen, p. 45, 106; Cloquet, Minn., cluster of diversified plants, object lesson in utilizing wood species, by H. Oldenberg, p. 49-50.

Lumber manufacturer and dealer, Jan. 23, 1925.—Better design of containers as a means of saving lumber, by C. F. Yegge, p. 21-2.

Lumber trade journal, Jan. 15, 1925.—Seed trees for profit or seed trees for show, by H. H. Chapman, p. 18.

Lumber world review, Jan. 10, 1925.—Wood flour: its manufacture and industrial uses, p. 29-30.

Lumber world review, Jan. 25, 1925.—Forest fire as a national menace, by E. T. Allen, p. 28-9; Limitations and possibilities of Clarke-McNary law, by E. A. Sherman, p. 30-2; The seventh Southern forestry congress, p. 35-41; Deferred taxes on forest land, by H. E. Hardtner, p. 37; National forests for the eastern half of the United States, by S. W. Allen, p. 37-8; Problems of hardwood timber production, by E. F. McCarthy, p. 38; Arkansas and Louisiana hardwood management problems, by J. B. Woods, p. 38-9; Why not more kinds of southern paper, by V. P. Edwardes, p. 39-41; American forestry association's semi-centennial, p. 42-5.

Mississippi valley lumberman, Jan. 23, 1925.—The American lumber standards: their meaning and present status, by A. T. Upson, p. 28-30.

Naval stores review, Jan. 3, 1925.—Steam distilled wood turpentine, by J. E. Lockwood, p. 16-17.

Naval stores review, Jan. 31, 1925.—Report on French distillation methods, by A. S. Carr, p. 23, 27.

New York lumber trade journal, Feb. 1, 1925.—Some possibilities of balsa, p. 37.

Paper, Jan. 8, 1925.—Facts of the board mill, by A. O. Bragg, p. 503-8.

Paper industry, Jan. 1925.—Reforestation in Canada, by E. Wilson, p. 1757.

Pulp and paper magazine, Jan. 8, 1925.—The problem of the world's timber supply, by F. Story and R. D. Craig, p. 29; The forest fire menace, by F. Kiefer, p. 31-2; Forest problems of the United States: the coming pulpwood shortage, p. 37-9.

Southern lumberman, Jan. 3, 1925.—Preventing sap stain losses, by F. A. Rother, p. 41; Gum as a pulpwood: saving gum wastes, by H. L. Beck, p. 42.

Southern lumberman, Jan. 10, 1925.—Christmas tree controversy, p. 40; Evolution of the log band mill, by F. G. Norcross, p. 42-4.

Southern lumberman, Jan. 17, 1925.—Chestnut appears doomed, by E. H. Frothingham, p. 43; Trend of dry-kiln design and practice by C. Cutler, p. 46-7.

Southern lumberman, Jan. 24, 1925.—Initial steps in state forestry legislation, by J. G. Peters, p. 35; Forestry congress considers means to perpetuate south's timber supply, p. 35-6; The shrinkage of wood and its relation to waste, by H. D. Tiemann, p. 43-4.

Southern lumberman, Jan. 31, 1925.—Growing trees for pulp and lumber at Bogalusa, by J. K. Johnston, p. 34; The industry's interest in the McNary-Clarke law, by W. Compton, p. 38.

Timber trades journal, Jan. 10, 1925.—The beauty of nature as revealed in wood, by W. Rayner, p. 95-100.

Timberman, Jan. 1925.—Fireproofing the forests, by N. F. Macduff, p. 49, 210; California sugar pine, p. 50-1; The lumber industry of Finland, by G. P. Blackall, p. 54, 212; Saw timber resources of Indian reservations, p. 62; Madagascar timber, p. 126; Wood toys from box factory waste, by C. Letts, p. 130; Oregon forests a renewable resource, by G. W. Peavy, p. 143-4; Relative volume production of redwood sprouts and seedlings, p. 146-8; The standard unit of wood refuse, by R. J. Gaudy, p. 150-2; Russia's timber program and prospects, p. 152-4; Is there a solution to our forest problem, by T. F. Hunt, p. 177-80; Perpetuating Pacific northwest forests, by F. H. Lamb, p. 194-202; Lumber standardization, by A. Upton, p. 204; Reforestation and banking, by C. C. Colt, p. 206-8; Japanese a wood-using people, by R. S. Fox, p. 208; Forest diseases and losses, p. 225-6; Suggested state reforestation act: text of bill to be introduced in Oregon legislature, p. 227-8.

Trade winds, Dec. 1924.—John Smith's timber problem, by R. S. Kellogg, p. 10-13, 24.

U. S. Commerce report, Feb. 2, 1925.—Timber resources in New Brunswick, by B. M. Rasmusen, p. 267.

Wood preserving news, Jan. 1925.—Tie treatment justified by 15-year test on C. B. & Q. railroad, by J. H. Waterman, p. 1-3.

Wood universal, Jan. 1925.—The work of the Southern forest experiment station, by R. D. Forbes, p. 14, 20-2.

Wood working industries, Jan. 1925.—Lumber needs of motor industry, p. 23.

Forest journals

American forests and forest life, Jan. 1925.—Where pagans practice forestry, by T. C. Zschokke, p. 3-6, 60; Will the chestnut come back, by J. S. Illick, p.

7-9; The drive of the Kaibab deer, p. 9; When all fires are out, by R. W. Ayres, p. 10-12, 54-5; President nationalizes living Christmas tree, p. 13; The Christmas chimney, by M. S. Kienast and E. B. Allen, p. 15-18; German woodsmen today, by C. A. Schenck, p. 19-21; Getting fun out of wood, by G. Day, p. 22-3; Forests and national playgrounds, by J. E. Scott, p. 25-8. 52, 54; Primitive justice, by W. G. Miller, p. 29-30; Tagging the elk, by W. C. Barnes, p. 35; Preserving wilderness beauty along forest roads, by H. M. Albright, p. 36-7; Pennsylvania's plan to purify her streams, by R. Y. Stuart, p. 42-4.

Australian forestry journal, Nov. 15, 1925.—Forest insects, no. 4; beetle borers from Borneo and the Philippines, by W. W. Froggatt, p. 283-6; The propagation of forest trees: simple instructions to farmers, by H. A. Goudie, p. 290-4; Durability of jarrah, p. 295; Air-seasoning test in western Australia, by S. A. Clarke, p. 296-7; A new form of botanical key, by S. L. Kessell, p. 297-301.

Bulletin de la Société centrale forestière de Belgique, Dec. 1924.—Le domaine des Epioux, by M. Favresse, p. 643-52; La pourriture rouge de l'épicéa en Belgique, p. 653-7; Le prix des bois en 1924, by E. Rosseels, p. 658-67.

Illustrated Canadian forest and outdoors, Jan. 1925.—Forestry in Ontario, by E. J. Zavitz, p. 13-14; Where we get our cork, by W. Thompson, p. 15-16; The story of Canada's forests, by C. D. Howe, p. 23-4; A new thought in fire prevention, by C. S. Cowan, p. 32-3; The school-child a forest ally, by C. D. Jarvis, p. 37; A plea for provincal parks, by C. W. Stokes, p. 46-8.

Indian forester, Dec. 1924.—The aero-photo-survey and mapping of the forests of the Irrawaddy delta, by H. R. Blanford, p. 605-16; The cultivation of conifers in northern India, by R. N. Parker, p. 616-21; Recent developments in the Punjab irrigated plantations, by R. M. Gorrie, p. 621-29; The normal sal selection forest, by C. G. Trevor, p. 638-44; Von Mantel's formula, by W. Schlich, p. 645-7.

Journal forestier suisse, Jan. 1925.—Sur le géotropisme du frêne pleureur, by P. Jaccard, p. 1-8; Résultats sommaires de quelques revisions d'aménagement dans l'arrondissement d'Aubonne (Vaud), by G. Berthoud, p. 15-19; Taxes vénales des forêts vaudoises, by M. Moreillon, p. 20-3.

Journal of forestry, Jan. 1925.—Recent progress and trends in forestry in the United States, by J. W. Toumey, p. 1-9; A forest policy for New York state, by H. C. Belyea and T. S. Woolsey, Jr., p. 10-19; A study of the growth of spruce and balsam pulpwood on cut-over ridge land in Lewis county, N. Y., by E. Richards, p. 20-29; In defense of brush, by H. G. Calkins, p. 30-3; A study in comparative lengths of tracheids of red spruce grown under free and suppressed conditions, by W. B. MacMillan, p. 34-42; Some ratios of form in Adirondack swamp spruce, by H. C. Belyea, p. 43-8; Control of bark beetles on the national forests, by J. F. Preston, p. 49-61; Artificial reproduction of California nutmeg, by W. Metcalf, p. 62-70; The use of the median in estimating standing timber, by A. Grasovsky, p. 71-7; Forest planting with a plow, by P. B. Haines, p. 95-6; The utilization conference, by A. Leopold, p. 98-101.

Oesterreichische vierteljahresschrift für forstwesen, 1924.—Unsere holzversorgung und forstwirtschaft, by K. Goethe, p. 1-19; Fünfzig jahre forstliche versuchsanstalt, p. 19-22.

Quarterly journal of forestry, Jan. 1925.—Reafforestation with cedar (Juniperus procera), Shume forest reserve, Tanganyika territory, by E. D. Maber, p. 6-12; Intensive silviculture, by E. R. Pratt, p. 13-19; Clear cutting or shelter-wood, by W. Schlich, p. 28-30; The conifer spinning mite or red spider by G. B. Ryle, p. 31-9; The Dublin arboricultural society, by A. Henry, p. 40-2; Report of the judges in the plantations competition of the Royal agricultural society of England, 1924, by T. Roberts and L. S. Wood, p. 73-80.

Revue des eaux et forêts, Dec. 1924.—Après l'incendie, by A. Barbey, p. 553-60; Le charbon de bois et le congrès des carburants nationaux, by A. Magnein, p. 561-4; Mesures de protection contre l'incendie dans deux forêts particulières de la Gironde, by P. Buffault, p. 565-74.

Schweizerische zeitschrift für forstwesen, Dec. 1924.—Eindrücke von der kantonalen zürcherischen ausstellung für landwirtschaft und gartenbau in Winterthur, 11-28. September 1924, by K. A. Meyer, p. 373-8; Einiges über das waldwegnetz, by A. Henne, p. 378-82; Zur geschichte der Winterthurer wirtschaftsplanrevision vom jahre 1846, by L. Weisz, p. 383-8; Die eichenschälwaldungen des Neckartales, by H. Müller, p. 388-90.

University of Washington. Forest club quarterly, Jan. 1925.—The fourth annual Washington state forestry conference, p. 5-51; Needed changes in forestry legislation, by F. E. Pape, p. 10-12; Reforestation, by G. C. Joy, p. 12-14; The cost of producing timber in the Pacific northwest, by B. P. Kirkland and E. T. Allen, p. 16-23; What is the next step forward in the state reforestation program, by C. W. Saunders, p. 24-7; What is the next step forward in the state reforestation program, by W. G. Weigle, p. 28-31; A proposed reforestation bill, by J. E. Calder, p. 31-4; The report of the forest taxation committee of the bureau of state development of the Seattle chamber of commerce, by F. J. Laube, p. 34-8; The report of the committee on forest taxation, state forestry conference, by C. S. Chapman, p. 38-40; Constitutional limitations on forest taxation, by H. A. Hanson, p. 41-4; The work of the state forest board, by C. V. Savidge, p. 46-8.

Yale forest school news, Jan. 1925.—The cruise of the Chapin estate, by H. H. Chapman, p. 3-4.

NOTES

FREDERICK OLMSTED DIES

As the Journal goes to press, sad news comes from California of the death of "Fritz" Olmsted. Another landmark of the profession has gone; another of the Last of the Mohicans has passed away. With "Fritz" forestry was not merely a career or a business profession; it filled his whole soul and he knew how to love forestry, fight for forestry and suffer for forestry. The Society of American Foresters owes "Fritz" an ever unforgetable debt for his moral courage in sticking to the ideals of forestry in the face of criticism and the sacrifice of his own personal fortunes. The Journal reserves, for a later issue, a fuller appreciation of what Frederick Olmsted's career meant to forestry.

REPAIRING DAMAGE FROM SNOW BENDING

The winter of 1922-23 was unusual in as much as we had fairly deep snow and very little frost in the ground. The snow crusted and then melted from the bottom causing a good deal of damage in small coniferous plantations.

This damage was very bad in a white pine plantation set in 1918. An attempt was made to save the damaged trees in order to continue the experiment without losing the growth of five years.

The damage consisted of a sharp bend about six inches above the ground. The angle in many cases being 90 degrees. The injuries could be classified into two groups, one with the bark unbroken and the other with the bark ruptured. All showed a very marked bulge at the point of bending.

The plantation was in cutover hardwood and an attempt was made to straighten the trees by propping them upright with small forked sticks. This work was very rapid; one man going over an acre in a few hours.

Inspections were made of the area at intervals to determine the results. It was found that where the bark was not ruptured the tree regained the ability to stand upright in two weeks. Where the bark was broken the tree died.

At the present time the only sign of the bending is a slight ridge at the point of bend. The results were satisfactory and a slight expense in form of time saved several years of tree growth and permitted the continuing of the experiment.

A. E. Moss.

FORESTRY TOUR THROUGH EUROPE

All those interested in a forestry tour through the leading European countries are invited to correspond with Prof. A. B. Recknagel, Cornell University, Ithaca, N. Y. The plans as tentatively made are for a two months' tour in the summer of 1926, starting from Montreal and taking in England, Scotland, Germany, Czecho-Slovakia, Austria, Switzerland and France. The tentative cost of such a tour is estimated at $800 per person, including all items with the exception of tips.

The trip would be under expert guidance and would stress the points of greatest interest to Americans in European forestry. Opportunity would be given to meet leading European foresters and to see at first hand the results of their work. The party must be limited to not over 40 and in the interests of economy the trip will be on cabin passenger boats sailing from Montreal and returning to that port.

DO FORESTERS NEED A CODE

Dr. Edgar L. Heermance of New Haven, Conn., has spent the past two years in a study of ethical codes in the United States. In reply to the question "Does the Society of American Foresters need a written code?" he answered as follows:

"The written code does not create ethics. It precipitates ethical sentiment. Any profession which has been in operation for 25 years should have developed from experience an unwritten code of ethics, enforced by the public opinion of the membership. On some points the ethical obligations of the members will be clear. Pressure can be exerted, and discipline enforced if necessary.

"On other points the unwritten standard is vague and indefinite. Each man is more or less a law unto himself. The public does not know what it has a right to expect of the group. Students entering it do not know what their professional obligations will be. A fringe of unscrupulous men are constantly engaging in questionable practices, for the sake of immediate gain, and bringing the profession into disrepute.

"The written code has been found the most effective means of meeting this situation. About 200 professions and industries have already adopted such an instrument. When the members in convention, or perhaps a series of conventions, attempt to put their standards on paper, they go through an educational process. Moot questions are discussed, and some agreement reached. Sentiment is clarified. The

code finally adopted, represents the "rules of the game" by which the members have agreed to abide. It expresses the things for which they see the profession needs to stand if it is to keep its professional standing and be permanently effective. The vigilance committee has been given an instrument which it can use in hearing complaints and enforcing discipline. Behind its action is an educated and organized public opinion, which knows what it stands for and why. The members are all on the same plane; unfair competition is largely eliminated. It is no longer possible for the unscrupulous man to hide behind the vagueness of the standard."

Should not this problem be raised at our next meeting?

Those interested in the codes of ethics adopted by accounting, advertising, agriculture, architecture, etc., should refer to the handbook entitled "Codes of Ethics" by Dr. Heermance. In his preface the author states that the purpose of publishing this collection of codes was three fold: (1) To facilitate the work of association officers. (2) To bring up evidence of this remarkable ethical movement. (3) To furnish material for teachers of ethics. Both professional and business codes are included, but the collection has been confined entirely to the United States. The compilation is based upon an inquiry of over 700 organizations.

Needless to say no forestry code is included. In commenting on Olmsted's report published in the "Journal of Forestry" (p. 89 Oct. 1924) Dr. Heermance writes, "I have been over the report.....consider it a very weak document. It tries to do what a code of ethics would do, in the way of setting a definite standard for the profession, but is vague and not at all comprehensive." In arguing the need for a forestry code, Dr. Heermance further states "You could call attention to what engineering and other professional bodies have done."

T. S. W., Jr.

SOCIETY AFFAIRS

MINUTES OF THE TWENTY-FOURTH ANNUAL MEETING SOCIETY OF AMERICAN FORESTERS AT WASHINGTON, D. C. DECEMBER 29 AND 30, 1924

First Day, Morning Session

The meeting was called to order by President Walter Mulford at 9:20 A. M. in the library of Central High School.

On motion of the Secretary, reading of the minutes of the Baltimore meeting was omitted inasmuch as they had been printed in the Journal of Forestry.

Mr. Chapline made an announcement relative to the plans of the Committee on Entertainment of the Washington Section.

E. H. Frothingham for the Executive Council reported the complete exoneration of Hugh P. Baker from charges of non-ethical conduct preferred by H. H. Chapman.

R. C. Bryant reported the activities of the year relative to admissions to membership. R. V. Reynolds read the Secretary's report, and F. W. Besley read the report of the Treasurer.

President Mulford discussed the Council's conceptions of its powers, and said that the Council at its recent meetings had assumed executive authority within reasonable limits. In view of the general understanding that the annual meeting is primarily a meeting for scientific discussion, without power to bind the Society, the impression of the Council is that its attitude is correct, but a resolution by the meeting to reconsider acts of the Executive Council will be regarded as a challenge requiring the action to be reviewed by the Council, and if not changed, to be submitted to referendum ballot of the entire membership. At this point Prof. R. C. Bryant read to the meeting the message of the Executive Council informing the meeting of the principal actions taken during the recent Council sessions.

Taking up the main program, President Mulford delivered his address.

Mr. H. B. Peirson of Augusta, Maine, read his paper on "Forest Protection: Insects." Mr. Jaenicke's comments on Mr. Peirson's paper were read in his absence.

Mr. Meinicke's paper on "Disease," together with comments, was

read by title in view of the absence of the principals and ordered to be printed in the Journal.

Mr. Clyde Leavitt read his paper on "Forest Protection: Fires." The comments of Redington and Osborne were read by title. At this point the President called upon Dr. C. A. Schenck, a visitor, to address the meeting. Dr. Schenck talked entertainingly on forestry, past and present, both in Europe and in the United States, laying special stress upon the value of human relations, cementing foresters in friendship following the war.

Mr. R. S. Kellogg took the floor and expressed approval of the Executive Council's action in holding its recent meetings, concurring in main with the action of the Council. He offered a motion that the meeting endorse the action of the Executive Council in its plan for the employment of a part-time secretary. Prof. K. W. Woodward inquired how the Council proposed to secure a full-time executive secretary later. President Mulford replied that education of the members was depended upon to change their attitude, and that by experiencing the benefits of a part-time secretary it is hoped that full financial support would be accorded. Prof. Woodward stated that the Society of American Foresters is now the only technical association of like aims having dues less than $10. Upon call for the question Mr. Kellogg's motion was passed unanimously.

Mr. Cheyney moved approval of the Council for the proposed increase of the Journal to twelve issues yearly. After some questioning from Mr. Carter and others the motion was passed unanimously.

Mr. Kellogg inquired relative to the rejection of the statement of policy prepared by Ex-President Hosmer, whether this action was intended to shut off further referendum. The President replied in the negative. Mr. Hugh P. Baker asked how the Society proposes to take leadership in years to come. The President replied that this was a difficult question to be answered on short notice, and would require consideration before a satisfactory reply could be made. Mr. Dana commented that if the Council disapproves entering into political matters, such as the support of specific bills, its Sections also should be forbidden to do so. Mr. Ellwood Wilson remarked that if we are not going to lead in public opinion, we might as well give up our profession. Prof. Hosmer voiced the opinion that we must eventually set up standards, and state maximum rather than minimum requirements. Mr. Kellogg remarked that the proper way of assuming leadership is to go and do it. He continued that in specific legislation the New York

Section is already making itself felt, and he offered the resolution "that during the coming year the Council or a suitable committee of the Council proceed to the definite formulation of the principles of a permanent forest policy for the United States." Carried unanimously.

Following an announcement relative to luncheoning places and the dinner of Section O, the meeting recessed at 12:35 P. M.

First Day, Afternoon Session

President Mulford called the meeting to order at 2:10 P. M.

Mr. Howard Weiss read his paper on "Forest Products Investigations" which was followed by the comments of Mr. Winslow and Mr. Fritz. These papers prompted a discussion by Major R. Y. Stuart to which reply was made by Mr. Weiss.

Mr. Winslow read the *Report of the Committee on the Place of Efficiency in Utilization* which called for a resolution by the Society that utilization is of equal value with other branches of forestry. Mr. Kellogg objected, and stated his belief that this action is undesirable and that the resolution should go to the Executive Council. He moved that the report of the Committee be received and referred to the Executive Council. Comments were made by Colonel Greeley and Dr. Schenck, the latter of whom said that logging is 80 per cent of forestry. Mr. Zon dissented, and stated that forestry and utilization should be brought closer together. Upon call for the question Mr. Kellogg's motion was carried.

Mr. Dana delivered his paper on "Forest Experiment Stations," the commenting papers by Munger and Koch being read by title.

Mr. Cuno read Prof. Bruce's paper on "Forest Mensuration," advocating the use of statistical analyses in preparation of our tables. Mr. Winkenwerder delivered his comment to the effect that he found Bruce abstruse, but nevertheless considered that foresters should be better acquainted with the methods of statistical analysis and should do more of the work advocated by Bruce. Mr. Behre read his comment. Further criticism was made by Austin Cary, Prof. Toumey, Ellwood Wilson, and others.

The paper on "Silvicultural Practice" was read by its author, Mr. Preston, who seemed rather pessimistic of the condition of silviculture in the United States. Mr. Munns' paper was read by title in his absence. Prof. Hawley took the floor as a commentator, disagreeing

strongly with the position taken by Mr. Preston, in which he was sustained by Woolsey, Toumey, and Dr. Schenck.

The meeting adjourned at 5:18 P. M.

Second Day, Morning Session

The meeting was called to order by President Mulford in the library of Central High School at 9:20 A. M.

Mr. Murphy read a summary of his paper on "Forest Taxation," and stated that he desired permission to complete his paper in some essentials and arrange for its publication in the Journal.

Prof. H. H. Chapman took the floor and read his comment, taking the view that the plan proposed by Murphy is not practical in any principal feature. Mr. Stevens' comment was read by title in his absence. Mr. Brannon, a tax expert in the Department of Agriculture, Bureau of Agricultural Economics, supported Mr. Murphy's views.

Mr. Cromie, of Connecticut, stated that he is employed by a municipality, and pleaded for unity among foresters in their demands for tax legislation. Dr. Fairchild of Yale delivered a strong and interesting comment and said among other things that the taxation value of forests is their wrecking value.

A paper, entitled "Gathering and Extracting Red Pine Seed," by A. H. Richardson, a Provincial Forester of Canada, was read by title and referred to the Journal.

Colonel Greeley presented his paper on "Forest Management on Federal Lands," comment being made by Prof. Kirkland, and Hall's comment was read by title in his absence.

"Forest Management on Private Lands," in the absence of Mr. Stevens, was read by title and referred to the Journal. The discussions by Cary and Wilson were presented by their authors.

Mr. Albert Gaskill read his paper, "The State Forester," on which comment was made by W. T. Cox. The other commentator, Mr. Pettis, was absent and his paper was not available.

Recess for luncheon was taken at 12:40 P. M.

Second Day, Afternoon Session

The meeting was called to order at 2 P. M., President Mulford in the chair.

Mr. Zon moved that the Society participate in the International Congress of Plant Sciences to be held at Ithaca August 16 to 23, 1926.

Upon nomination by Mr. Kinney, Prof. Hosmer was appointed by the Chair as the delegate of the meeting to the committee preparing the preliminary program for this Congress.

Dr. Sampson's paper on "Range Management," which had been omitted on the previous day, was read by title together with comments by Rachford and Jardine.

Reviving the discussion of Gaskill's paper, Prof. Winkenwerder stated that he disagreed with Gaskill's conception of the use of land and raising timber. Major Stuart denied that in Pennsylvania at least the Federal administration of the Weeks Law is unsatisfactory. He stated that there is no interference and that the desired cooperation is proceeding in a very satisfactory manner. Chapin Jones, Forester for Virginia, stated that administration is equally satisfactory in that state, that budget systems are removing the corrupt conditions of bygone days and the administration of the state government is improving tremendously. He believes that the states are now competent to handle such forests. Further comment was made by Mr. Carter.

Mr. Kirkland read his paper on "Timber Supply and Demand," after which Prof. Recknagel and Mr. Sparhawk delivered their comments and the comment of A. W. Cooper was read by title.

Mr. O. M. Butler being absent on account of illness, his paper on "Public Sentiment" was read by title and referred to the Journal. As the other commentator, Mr. Silcox, was absent, Mr. Kellogg requested that his comment also be omitted.

Col. H. S. Graves read part of a lengthy paper on "Forest Education" which was followed by the comments of Prof. Ferguson. In the absence of Mr. Forbes his comment was read by title.

Mr. Preston took the floor and made remarks in rebuttal and coordination of the differences between his views expressed on the previous day relative to silvicultural practice and those expressed by Prof. Hawley and others of New Haven.

Mr. Dana was called to the floor to explain to the meeting his recent activities with the Rockefeller Foundation in the interest of international statistics and education, and told of the need for a new standing Committee on International Relations. He moved that the meeting endorse the action taken by the Executive Council relative to the establishment of such a committee. Mr. Zon amended Mr. Dana's motion, stipulating that Dana himself be selected as Chairman of this Committee, the other two members to be appointed by the incoming

President. This motion was seconded by Mr. Kellogg and carried unanimously.

The report of the *Committee on Standardization of Forest Fire Practice* was presented by Major Stuart who said that the Committee had adopted a standard form for reporting forest fires and that a number of conferences had been held at which it had been found that standardizing methods of estimating damage is not so easy. At these meetings representatives of the U. S. Forest Service, the State Services, and the Society were present and investigated conditions in estimating damage. They found it necessary to leave the question unsettled for the time and asked the continuation of the Committee. The meeting approved the report and ordered it placed on file.

The report from the *Committee on Sections by its Chairman,* A. J. Jaenicke, was at hand and in the absence of the author was ordered to be placed on file.

For the *Committee on Dictionary* Mr. Zon reported no progress, and moved that the Committee turn over its functions to the Committee on International Relations inasmuch as they would have need for activities of precisely this kind. This motion provoked some mirth, and was left without a definite decision.

The report of the *Committee on History of Forestry,* by Prof. Hosmer, was ordered placed on file.

Mr. Sparhawk took the floor and reported as our delegate in a committee he had just conferred with in the Union of Biological Societies. He reported the various activities of the recent meeting attended, and moved that a request from the Union of Biological Societies for a contribution from the Society of American Foresters be referred to the Executive Council. Carried.

Mr. Zon moved that no action be taken looking to competition of our members for the prize offered by the American Association for the Advancement of Science for the best scientific paper presented at these meetings. Carried.

Prof. Recknagel described Ithaca in glowing terms, and urged it upon the meeting as a desirable meeting place for the Society in June, 1926, in especial consideration of the meeting of the International Congress of Plant Sciences to be held there at that time.

Mr. R. C. Hall moved that the meeting instruct the Secretary to send to Dr. Filibert Roth a message of friendly greeting. Carried unan-

imously. This action was followed by a rising vote of thanks offered to the Committee on Entertainment for the success of their program.

The Secretary read the announcement of the 1924 elections.

Prof. Recknagel proposed a vote of thanks to President Mulford for his excellent conduct of the meeting. Carried. A similar vote of thanks was extended to the Secretary and Treasurer for their management of Society business during the year.

The final session adjourned at 5:46 P. M.

The total registered attendance at these meetings was six Fellows, 112 Senior Members, 26 Members, six Associate Members, and 32 guests, making a total of 182. Several others failed to register.

R. V. Reynolds, *Secretary.*

REPORT OF THE TREASURER
1924

Receipts

Balance on hand, Jan. 1, 1924		$2,334.06
Annual dues:		
1921	$ 5.00	
1923	229.05	
1924	3,707.94	
1925	46.90	
		$3,988.89
Subscriptions to Journal:		
1923, Vol. 21	$ 59.50	
1924, Vol. 22	2,452.42	
1925, Vol. 23	315.65	
		2,827.57
Sale of back numbers, etc.:		
Journals	$ 218.89	
Forestry Quarterlies	88.50	
Proceedings	45.90	
Lists of members	2.00	
		355.29
Advertising:		
By commercial institutions	$ 158.60	
By educational institutions	65.00	
		223.60

Society pins	33.40	
Refund on D. C. postal deposit	21.72	
Interest on bank deposit	122.27	
Special funds:		
Gift from Charles L. Pack	$1,000.00	
Interest on bonds	42.50	
	1,042.50	
Total		$8,615.24
Grand total		$10,949.30

DISBURSEMENTS

Publication and distribution of Journal:		
Printing and mailing Vol, 21 No. 8	$ 503.37	
Printing Vol. 22, Nos. 1 to 7	3,909.37	
Line cuts and half tones	38.99	
Preparing copy and proof reading	150.00	
Postage	174.06	
Stencils	12.26	
Envelopes for mailing	80.00	
Postal deposit for 1925 Journals	50.00	
	$4,918.05	
Miscellaneous printing:		
Bill heads	$ 21.00	
Rate sheets	8.50	
Subscribers' cards	9.25	
Membership blanks	5.25	
Form letters	6.90	
Lists of candidates	116.00	
Ballots	44.20	
	211.10	
Stationery and postage (exclusive of Journal):		
Stamped envelopes	$ 159.50	
Stamps	81.84	
Paper	21.80	
	263.14	

Clerical and stenographic work	465.55	
Addressing envelopes and folding	18.75	
Telegrams and telephone calls	14.58	
Express	15.35	
Freight	3.77	
Society pins	33.20	
Refunds on subscriptions, etc	18.10	
Folders for letter files	2.50	
Copy of "Forest Resources of World"	9.08	
Total		$ 5,973.17
Balance on hand		4,976.13
Grand total		$10,949.30

ASSETS

Balance on hand		$4,976.13	
Annual dues:			
6 at $5.00	$ 30.00		
4 at $4.00	16.00		
		46.00	
From sale of "Forest Resources of World"		3.00	
Sale of back numbers		1.30	
Advertising		100.00	
Bonds for investments		1,000.00	
Postal deposit paid in advance		50.00	
Total			$6,176.43

LIABILITIES

Dues paid in advance	$ 46.90	
Subscriptions paid in advance	315.65	
Clerical and stenographic work	43.00	
Printing and mailing December Journal	711.07	
Miscellaneous printing	36.80	
Stencils	7.60	
Expenses of annual meeting	26.95	
Total		$1,187.97
Excess of assets over liabilities		$4,988.46

Special Funds

One $500 bond	$ 500.00	
Five $100 notes	500.00	
		$1,000.00
Interest on above:		
1922	$ 7.98	
1923	42.40	
1924	42.50	
		92.88
Contribution, emergency fund		20.80
Contribution, permanent fund		15.00
Gift from Charles L. Pack		1,000.00
Interest on above:		
Feb. 1, 1922 to Dec. 31, 1924		7.12
Total		$2,135.80

F. W. Besley, *Treasurer.*

Audited and found correct by S. B. Show and L. L. Bishop.

CONTENTS